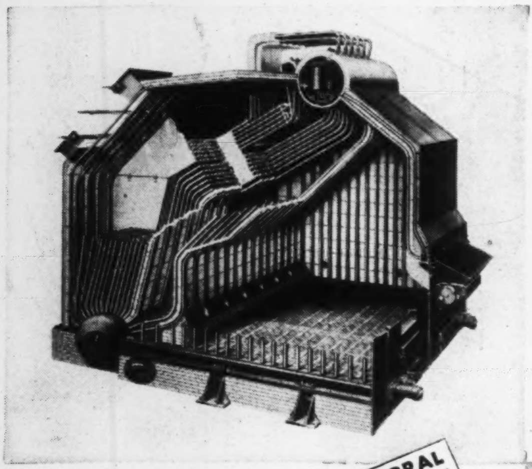
2 1948

MECHANICAL ENGINEERING

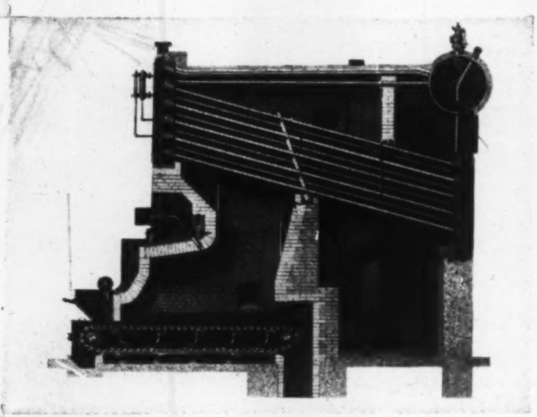
· FEBRUARY 1948 ·



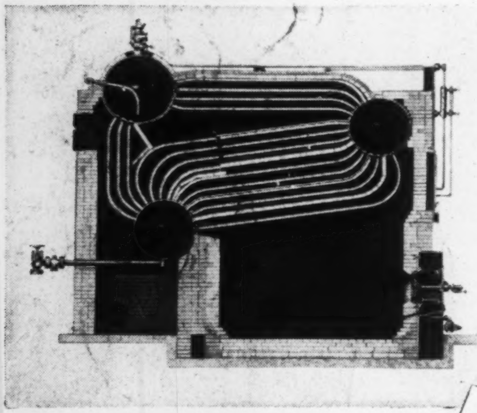
Big BENEFITS ARE "WRAPPED UP" IN THESE THREE SMALL BOILERS... B&W "CUBS"*

INTEGRAL FURNACE BOILER

Design 32, Type H Stirling, and Type FF Integral-Furnace Boilers were specifically designed for this purpose: supplying steam requirements from 10,000 to 50,000 lb. per hr. and more at pressures above 160 psi, with definite cost-saving benefits to their users in installation, operation and maintenance.



DESIGN 32 BOILER



ALL are fully coordinated, flexible units — from fuel burning equipment to breachings and stacks—built and installed under undivided responsibility.

ALL are time-tested, performance-proved units of simplified design and standardized manufacture.

ALL fully meet modern requirements as to fuel flexibility, compactness, ease of operation, fast-steaming and ability to take sudden load swings.

ALL sustain high operating efficiency over their wide range of output, and generate steam of satisfactory quality at all ratings.

ALL have provision for the addition of steam superheaters.

ALL embody design, construction and operating features that account for the heavy preference for larger B&W boilers for central stations and large industrial applications.

ALL are matched to their jobs for highest standards of performance, continuity of service and long-term economy.

TYPE H STIRLING BOILER

*Complete Unit BoilerS

Each as much a package boiler as any unit its capacity can be.

G-382

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
GENERAL OFFICES: 85 LIBERTY ST., NEW YORK 6, N.Y.
WORKS: ALLIANCE AND BARBERTON, O.; AUGUSTA, GA.

MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 70 NUMBER 2

Contents for February, 1948

SCIENCE AND THE WHOLE MAN . . . . . *E. W. Sinnott* 113
RESEARCH ON RUBBER FOR MECHANICAL ENGINEERS . . . *J. F. Downie Smith* 118
PRODUCTIVITY—PRICES AND MARKETS . . . . . *A. E. Dodd* 123
GANTT AND DODD . . . . . *J. M. Hancock* 125
UNDERGROUND GASIFICATION . . . *M. H. Fies and W. C. Schroeder* 127
THE ORIGINAL FROUDE HULL MODELS . . . . . *H. P. Spratt* 136
LONG-RANGE INDUSTRIAL PLANNING . . . . . *D. C. Prince* 137

EDITORIAL 111
BRIEFING THE RECORD 143
ASME TECHNICAL DIGEST . . . 157
COMMENTS ON PAPERS 162
REVIEWS OF BOOKS 163
ASME BOILER CODE 165
ASME NEWS 169
ASME JUNIOR FORUM 175
CONTENTS OF ASME TRANSACTIONS . . . 190

INDEX TO ADVERTISING PAGES 122

OFFICERS OF THE SOCIETY:
E. G. BAILEY, *President*
K. W. JAFFE, *Treasurer* C. E. DAVIES, *Secretary*

PUBLICATIONS STAFF:
GEORGE A. STETSON, *Editor* FREDERICK LASK, *Advertising Mgr.*
K. W. CLENDINNING, *Managing Editor*

PUBLICATIONS COMMITTEE:
H. L. DRYDEN, *Chairman*
J. M. JURAN JOHN HAYDOCK
R. B. SMITH C. B. CAMPBELL

ADVISORY MEMBERS OF THE PUBLICATIONS COMMITTEE:
HUNTER R. HUGHES, JR., ATLANTA, GA.
Junior Members:
LOUIS FELD, NEWARK, N. J. JOHN H. PRENTISS, NEW YORK, N. Y.

Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Dynamic," New York. Price 75 cents a copy, $7.00 a year; to members and affiliates, 50 cents a copy, $4.00 a year. Postage outside of the United States of America, $1.50 additional. Changes of address must be received at Society headquarters three weeks before they are to be effective on the mailing list. Please send old as well as new address. . . . By-Law: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4). . . . Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879. . . . Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921. . . . Copyrighted, 1948, by The American Society of Mechanical Engineers. Member of the Audit Bureau of Circulations. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author, and that date of publication be stated.

Westinghouse Electric Corporation

Mercury Vapor Lamps in Manufacturing Aisle

VOLUME 70
No. 2

MECHANICAL ENGINEERING

FEBRUARY
1948

GEORGE A. STETSON, *Editor*

ASME Publication Plan

EXPERIENCE has shown that whenever the ASME has changed its publication procedures it is necessary to repeat frequently and in simple terms the essential elements of the changes. In respect to the change voted upon by the members in September, 1947, and put into effect by the Council as of Jan. 1, 1948, frequent repetition is going to be necessary, not only because of the change itself but because modifications were made in it at the time it was put into effect with a view of meeting some of the objections that were raised and of easing some of the hardships it imposed.

Under the new plan as modified the Transactions (eight issues per year) and the *Journal of Applied Mechanics* (four issues per year) have been put on a subscription basis. The annual rates for members are: Transactions, $4; *Journal of Applied Mechanics*, $2.50; or both (twelve issues) $6. Nonmember subscription rates are double.

The purpose of this change was to reduce waste and expense. Costs of materials and labor have increased. It is generally conceded in publications like the Transactions that less than 5 per cent of the members are sufficiently interested in any one paper to read it. But it is impossible for anyone to know what papers will interest any individual member. When costs are low and membership is small, there is little waste in sending every member every paper and letting him decide for himself what papers he desires to read. Under conditions which prevail today, however, costs can be nearly halved and the tonnage of paper reduced to a relatively small fraction, if a device can be formed by which a member gets only the papers he intends to read and use. This was the problem that confronted the Society.

The solution was to put the Transactions and the *Journal of Applied Mechanics* on a subscription basis and to publish in a new department in MECHANICAL ENGINEERING, digests of all of the papers published in these magazines and to sell to the members who did not subscribe individual copies of the papers. The member makes his choice of the individual papers he desires to read on the basis of the digest. The digest scheme has other advantages for the member which, the Committee felt, would make up for the additional expense which the member would have to meet. It provided a means by which papers not published by the Society could be brought to the members in digest form together with the opportunity to purchase mimeographed copies of them at a nominal rate. When it is considered that the Society can publish only half of the papers presented at meetings, it will be realized that the members are receiving a valuable service in the digests and that MECHANICAL ENGINEERING becomes a means by which every paper for which the author has submitted a manuscript can be brought to the attention of readers in full or in digest form and that a mechanism is set up whereby printed or mimeographed copies of all papers can be procured by those who desire them.

To simplify the problem of ordering and paying for individual copies of papers the Society has devised a scheme of coupon books. A coupon book containing 10 coupons and having a face value of $2.50 may be purchased for $2, and one containing 20 coupons, face value $5, may be purchased for $4. Nonmember rates are double these amounts.

The member vote on the new plan was large and was favorable to it by approximately 8 to 1. Naturally, several letters critical of the scheme and some offering helpful suggestions have been received at Society headquarters. The basis of some of the criticisms was removed when the Committee decided to put the Transactions on a subscription basis instead of requiring a member who desired a considerable percentage of papers to purchase them individually or wait until the annual volume was ready for distribution. Other criticisms have been met by the introduction of the coupon-book scheme. If these features could have been incorporated in the original plan, which was impracticable at the time, the vote of the members might have been even more favorable than it was.

The Committee hopes that the members will give the new plan a fair trial and attempt to understand it and benefit from its valuable features. Comments and criticisms are solicited. Further modifications may be introduced as they can be worked out, but for the time being the Committee feels that it must have several months of experience with the plan as it now stands before it can do so. In the meantime, the plan is under continuous observation and study.

The Whole Man

DEVELOPMENT of the whole man is a task which is demanding a growing degree of importance in every phase of our national life. Its formal phases are the responsibility of educational institutions—the schools and the colleges and universities. Closely supplementing these institutions in their effectiveness and sharing in the responsibility are religious organizations, community groups, and the learned and professional societies, of which The American Society of Mechanical Engineers is but one of many. But none of these agencies can be fully effective if the individual himself is not responsive and if the conditions of family life do not provide example, incentive, and an appreciation of values, plant the seed and nurture the tender plant of this development, and have faith in the satisfactions and service, which are its fruit. For the development of the whole man involves not only breadth and depth of a well-rounded mind and character, but the entire life span of the man as well, and all of his activities, no matter how important or how insignificant they may appear to be.

In an article in this issue E. W. Sinnott has directed attention to science and the whole man. His article is evidence of a general movement under way in many areas of society today which tends away from narrow specialization that is not enriched by a broad culture and is imbued with a sense of direction and purpose which comes only with the development of the whole man. As Director Sinnott says, "The greatest peril now is not from lack of education but from one-sided partly educated men."

Although Director Sinnott is himself a scientist and is writing specifically about science and men of science, his thesis is equally applicable to engineering and engineers and, as has been pointed out by others, to the arts and to artists. The theme is not a new one. It has been developed in this magazine on several occasions and by several writers. When The American Society of Mechanical Engineers made its study of the earnings of its members in 1930 the fact, frequently pointed out by engineers and teachers, that the engineering graduate almost inevitably became an administrator as he advanced into the mature years of his career, was confirmed, and it was this circumstance which led Elliott Dunlap Smith to emphasize the need for engineers to develop into men of full habit of mind. The astounding contrasts thrown into bold relief by alternate periods of prosperity and depression in a nation which has developed material progress to the advanced stage found in the United States in our own generation, and the spectacle of nations able to develop their natural and human resources with the aid of science and engineering for the purposes of mutual distinction but weak and ineffectual in providing and guaranteeing the most precious rights of their citizens in times of peace or even of establishing a lasting and universal peace, have convinced many persons that a materialistic and mechanistic approach to life is not enough.

The material contributions of science and engineering have had their beneficial influences, but coupled with progress in these fields has been a lack of progress and development in others—the fields of the spirit, of morals, of ethics, for example, upon which society must depend also if it is not to destroy itself. What gives special significance to Director Sinnott's article is the fact that it is an admission of the scientist that he must assume responsibility in an area of human affairs in which traditionally he has disclaimed it.

Discussing this same problem in the field of the arts, Olin Downes, music critic of the *New York Times*, recently wrote: "We hold the theory that citizens of average intelligence and experiences are the ones competent to shape the affairs of the community, while individuals of exceptional intelligence and leadership in fields of thought and beauty are incapable of doing so, to be as disproportionate as it is antediluvian. Modern society should have gotten farther than that by this time. It is an idea born of a civilization as complacent and opportunistic in its methods as it is fearful of any and all ideas not completely in accord with regimented precepts of the past, and its incapacity to predict the consequences of its actions from any other than this purblind viewpoint."

Mr. Downes reports Koussevitsky as viewing the contemporaneous artist "not only as an interpreter of masterpieces but also as the interpreter of the human and social issues of his period." And he quotes the musician as saying: "The blame for existing conditions in this respect rests not only upon the age, the present period, and the traditional order of the society in which they exist, but upon the artists themselves."

So we have testimony from opposite camps, as it were—the scientists to whom things of the mind are of prime importance, and the artist with whom things of the spirit are dominant—which point to the need for our educational and social processes to work toward the development of the whole man.

Science not only admits the need for the development of the whole man; it also provides a means by which all areas of the rational life may be improved. In this connection it will be useful to quote again from an inspiring article by a scientist-philosopher, E. F. Caldin, writing in *Endeavour* for April, 1946. After pointing out that natural scientists use a particular version of rational method he continued: "Historians use another version, philosophers yet another; craftsmen, businessmen, housewives, all have their own special rational habits adapted to the work in hand. The method of natural science is not the sole and universal way of reading truth; it is one version of rational method, adapted to a particular set of truths....Large numbers of people have been misled into thinking that the procedure of natural science is the royal road to truth in every field, that what cannot be proved by science cannot be true, and that metaphysical propositions, for example, are meaningless or at any rate unprovable. The mistake here lies in confusing the part with the whole—scientific method with rational method. But we can substitute an important truth for the mistake if, agreeing that science is not to be divorced from other rational pursuits, we find their connection in this: that science is not only a version but a microcosm of rational life. By this is meant that in studying science and becoming familiar with that form of rational activity, one is led to understand rational life in general; one grasps the principles of all rational procedure through practice in one form of it. It should then be easier to adapt those principles to other studies and to life in general. Scientific work, in short, should be a school of rational life."

However we approach it, from the point of view of the engineer, the scientist, the artist, or the ordinary citizen, what the world needs, and needs desperately, is the development of the whole man.

SCIENCE *and the* WHOLE MAN

By EDMUND W. SINNOTT

DIRECTOR, SHEFFIELD SCIENTIFIC SCHOOL, YALE UNIVERSITY, NEW HAVEN, CONN.

Man, not matter, is the chief problem of the world today. If we train his mind to master material things without at the same time enlarging his spirit so that he may appreciate the value of immaterial ones and thus become the master of himself, he is but half a man. The greatest peril now is not from lack of education but from one-sided partly educated men. Only whole men can save the world today and to train them well is the imperative task of every university.—E. W. SINNOTT.

THIS week we celebrate the end of a momentous century. These hundred years have witnessed changes in the life of man much more profound than have occurred in any similar period in the long history of civilization, changes which are chiefly due to rapid advance in all the sciences. The opening of what we now know as the Sheffield Scientific School, in Theodore Woolsey's presidency at Yale during the eighteen forties, was a notable event for science in America. Director Chittenden, in his history of our School, shows how its founding and that of similar institutions elsewhere marked the beginning of that active advance of science on this side of the ocean which has had such important consequences for us all.

To list the notable steps in scientific progress and the many ways in which our physical lives have been affected by them would be to rehearse a long and familiar story. Science indeed has made for us a new world. Upon an occasion like the present one, however, it may be more profitable, perhaps to dwell upon the influence which science has exerted upon human thinking, for though its ministry to our bodies is familiar, we have too little noted what it has been doing to our minds. The changes wrought there are more subtle but no less profound, and in the long course of history they well may prove more significant for the fate of man than was the industrial revolution or the discovery of atomic energy.

ATTITUDE OF SCIENCE TOWARD MANKIND

Science has greatly widened our horizons and we know today far more about the world and our own selves than did our ancestors 100 years ago. We are penetrating into the recesses of the material universe. We have traced the agelong history of our earth and of the living things which dwell upon it. The physical basis of life, in protoplasm, is yielding now to the searching analysis of biophysics and of biochemistry. These great ideas have helped to liberate men's minds from bondage long imposed by ignorance and dogma, and this progress of a century in our mental stature is surely a notable triumph for the sciences in their long service to humanity.

But it is not these gains in knowledge of the universe, important though they are for human thinking, which form the most important contribution of modern science to the mind of man. Not only the content of his mind has changed, but its whole orientation, also. For centuries he looked behind him for the Golden Age—backward toward Rome, or Athens, or Jerusalem. Always the great days were in times long past. Perfection was in Eden, when the morning stars all sang together, and this high estate from which man fell would never be regained on earth again. Not till the eighteenth century did men think much of progress or of a golden age to come toward which they might aspire. Political and then industrial revolution now set the face of the western world straight toward the future and its promises, a change with which the accumulating triumphs of the sciences had much to do. Progress was in the air. Astronomy and physics and chemistry and biology and all the other disciplines of science moved on so far beyond the levels of the past that men began to live in a new world. Whatever might be true of the arts and the philosophies, in science surely there was progress now, firm and indisputable and leading on to greater progress still. The demonstration that all living things have risen to their present high estate from simpler origins seemed to our grandfathers quite proof enough that progress was indeed a law of nature and that of necessity man's course would keep on upward till the millenium was gained. The latter years of the last century were comfortable with such assurances.

This change in the direction of our thinking has been stimulating, exhilarating. It has altered the intellectual climate of the western world. In the sciences men find no vague and quibbling scholasticism, no tossing about of opinion without proof, but a sound and logical system of expanding knowledge based on the intellect alone and freed from unintelligible mysticism. Here one deals with facts—measurable, quantitative, subject to critical and objective test. Here is the widening frontier in the empire of man's mind from which he pushes out into the unknown to high adventure. Here is the powerful tool which in our generation has altered old conceptions of matter and energy and the construction of the universe and promises still greater things to come. We cannot wonder that this intellectual revolution and the resounding successes it is winning have given science an immense authority not only among those who practice it but with a great and growing body of laymen. It has captured their imagination and become for many the supreme discipline, fit to command allegiance from all thinking men.

The most important consequences of this dominance of science are the changes it has wrought in the philosophy by which men live. The philosophy of science is a hardheaded one—objective, materialistic, forward-looking. It is based on matter and energy, on tangible and material things, subject to discourse by the mind alone and ultimately to be analyzed in terms of mathematics. The arts it appreciates as means for cultivation and enjoyment, but it rejects the poet and the mystic as safe guides to truth. It is deterministic and bows down to physical laws. It is little concerned with values or purposes. Reason, not faith, is its watchword. Its ethical code and its religion (if it has one) are centered around man and man alone.

This is no new philosophy, of course, but it has greatly thriven with the growth and popularity of science. Its chief significance lies in the attitude which it assumes toward man

---

An address delivered at the Centennial Celebration of the Sheffield Scientific School of Yale University, Oct. 17, 1947. Reprinted with permission of the *American Scientist*.

and his place within the universe. Science regards a human being not as a soul which may be saved or lost but as an exquisitely constructed physicochemical mechanism, and among the most significant of its discoveries are those which have revealed the operation of this bodily machine. A vast array of evidence from biology and the medical sciences shows that each of us is a biochemical system, elaborate beyond the ability of science yet to analyze but subject more and more to intelligent control. The day of human engineering has begun.

HAS MAN'S MIND OUTRUN HIS SPIRIT?

Therefore in all our efforts toward the betterment of man, the protagonists of science now demand that it should occupy no secondary place, should be no longer a mechanic and servant only. It should take command. Its mastery of material problems by use of the sharp tools of intellect alone has been successful in such high degree that the same methods now should be applied to that most complex piece of matter, man himself. The time has come, these critics say, to get rid of emotion and mysticism and wish-fulfillment and all the tangle of illusion through which man long has groped and to follow the white light of reason only. They are increasingly impatient with any plan for salvation save by material means. Let us make sure, they say, that men are well housed, amply fed, freed of disease, given security, education, and leisure, and let them fret no longer about their sins or their souls or any curious longings they may have for something more. How much better off we are, says Hogben, since we have learned to worry less about the good life and more about good sewers. This program for human betterment, founded on a philosophy of scientific rationalism, is so simple and logical, so clearly in harmony with the modern spirit and so fruitful already in accomplishment that it exerts a most profound appeal. It offers a bright hope, and indeed to many the only hope, for a better and a happier world.

But one who faces the hard facts of history today, however confident he still may be, can hardly say that all is going well with man. A world which two great wars have plunged into dark years of doubt and disillusion has learned at last that progress in the sciences, certain and permanent though it surely is, by no means brings true progress for mankind. Our western world may well be sweeping downward to its doom. The boasted progress of all civilization is a precarious and reversible achievement and no necessity of nature, after all. What once we confidently thought to be the triumphant advance of civilized society, implemented by the discoveries of science, may well prove but a transient and unlovely phase of man's long history, a machine-made and materialistic era and no way station on the road to the millenium. To many thoughtful minds the gains of science are secondary and superficial things. The growing complication of our knowledge, the evidence for atoms and quanta, for genes and viruses and island universes are at the last, for them, no more than vanity and vexation of spirit. Indeed, the world's unhappy state today is in no small measure due, they charge, to science and the changes it has wrought. We live in a fruitful world but one where millions are still hungry and fearful; where life is easier but unrest grows deep; where leisure is increasing but taste and morals steadily decline; where transport and communication are swift but suspicion between peoples ever mounts; and where knowledge of the ultimate nature of the universe, the climax of astonishing advances in the sciences, has dragged a startled world to the brink of actual physical destruction. This is not progress, declare the critics of science, but retrogression. The great gains of the past are being lost in a chaos of materialism and despair. Man, who should be lord of creation, is being mastered by matter. Knowledge without wisdom is not only fruitless, but terribly dangerous. Man's mind has outrun his spirit. Science is not the guide but the betrayer of humanity.

Our only hope in these dark days, such men believe, is to cultivate again those wise, humane, and liberating disciplines which through the centuries have ministered so fruitfully to man and which can free him from the prison of materialism. We must explore the wisdom of great minds, the avenues to beauty, and all other means through which his spirit has learned to feel the grandeur and the mystery of the universe and to love his fellow men. In all our quest for light, they say, what shall it profit us to learn the whole wide gamut of the physical spectrum if then we cease to seek that light that never was on sea or land?

This contrast between the philosophy of science and that of what we sometimes label the "humanities" is rarely drawn as vividly as this, but it confronts us everywhere today. The issue is not new. Here lies the ancient controversy between materialist and idealist, skeptic and mystic, doer and seer, reason and faith, Occident and Orient. This difference seems to be almost congenital and rooted in the basic differences between what William James once called "tough-minded" and "tender-minded" men. In all the centuries, however, it has never yet disrupted human life or proven a serious threat against our peace. Why, one may ask, should we now raise this ancient argument again?

MATERIALISTIC PHILOSOPHY WIDELY HELD TODAY

There is, I think, a pressing reason why today this problem must be given earnest study. It is no longer one of academic interest merely, but has assumed an ominous importance for us all. What a man really believes about himself, his fellows, and the universe in which he lives is bound to influence profoundly what he does. The springs of human action are not always clear, but certainly of great importance for our destiny are the underlying philosophies of men. Western civilization—what our fathers well called Christendom—possessed a relatively uniform tradition in ethics and philosophy. Objectors and agnostics there have always been, but never many. Not so today. Rebels to the old tradition come now not by scores but millions. A materialistic philosophy is held today not by a few tough minds but by whole blocs of men throughout our western world. Openly avowed, quietly assumed, or even unconsciously adopted, it has become the creed of hosts of men and women. Communism has embraced it as orthodoxy. In this great change the vast authority of science and the wide dissemination of its knowledge has had a most profound effect. The opposition between this modern materialism and the ancient and urbane humanistic tradition is no longer a matter for seminars and academic disputation only. The issue bites deeply into the underlying convictions of millions of men who are beginning to translate their beliefs into action. This action will decide their fate and ours. The influence of science in shaping thus the minds of men in a restless and explosive age of clashing ideologies will be of far greater moment, I believe, than its contribution to technology and to the physical basis of our lives.

CAN OPPOSING PHILOSOPHIES BE HARMONIZED?

Is there no way by which these opposites may now be harmonized? Can we not bridge the chasm which thus makes for civil strife within the mind? The extremists on both sides at once say, No! The poet and the man of faith affirm that only through man's spirit, through intuitive understanding, can he touch the true reality. Those who have harder heads will toss this attitude aside as hopeless mysticism, irrational and false. Most men cannot decide on either course, and make attempt to live a double life, reserving their confidence in matter for those austerer hours spent in the study or the laboratory but elsewhere living the free life of hopeful, anxious, undetermined men. The Hyde who holds discourse with science is a different man from the Jekyll of art or politics or religion. This divided allegiance is accepted as inevitable by many who frankly say that man must live in two worlds and that he should not mix his science with his art or politics or religion. But such duality can hardly offer a sound basis for any satisfying life philosophy. At best it is demoralizing, at worst, perilous. Mind cannot serve two masters, cannot maintain this double standard for the truth. Today's most challenging and necessary task is to seek out a basis for agreement between these two philosophies, a common ground on which the sciences and the humanities may stand together, not as contenders for the mind of man but as equal partners in its service.

To explore again the possibility of bringing this to pass is worth some effort. So many attempts to reconcile, as the word is, science with religion, free will with experimental determinism, common sense with the inexorable logic of the laboratory have proved futile and so great is the difficulty of avoiding those snares which here wait for the unwary that a judicious person hesitates to add to a mass of argument which so frequently proved sterile and inconsequential. But the danger of continued opposition between these two philosophies, dramatized today by the intense ideological conflict between communism and democracy, is now so serious that one is justified in risking some opprobrium if there is a chance to aid in bringing together these two competitors for our allegiance.

IS INTELLECT THE ONLY GUIDE TO TRUTH?

The issue is indeed a great one. It involves man's never-ending quest for what at last must be his highest goal, a knowledge of reality, of the truth about himself and the universe and their relation to each other. Along what avenues, one must ask, can we now travel toward this end, confident that they are leading in the right direction and will avoid the false "truths" which so often have lured travelers to error and to folly? Even to define the terms of the quest is difficult, and I shall not here become entangled in the meshes of epistemology. What we seek to know is really this: Is intellect the only guide to truth and do all ultimate certainties thus come through science, or are there other valid avenues, different but equally worthy of exploration, which we should not neglect?

No one can doubt that intellect is the most efficient and precise of tools we have for finding truth, for marking out incontrovertibly whole areas of reality. It is a relatively modern tool and hardly older than man himself. It had its origin, perhaps, from man's use of implements and thus from his discovery of the relations between objects which lay around him. Growing with the years, it lifted him out of his subjective and self-centered life and showed the orderliness of material events. Long fearful and perplexed and credulous, he began to make progress in the tremendous task of gaining an understanding of the world and grew more able to employ his intellect alone, avoiding the temptations to emotion and desire in thinking. Man's history records the gradual liberation of his mind which led at last, in the great days of Greece, to the beginnings of that science which we know. Still further freed from authority, custom, and tradition, science has progressed to its present high estate as the chief triumph of man's mind. It has enabled him to construct a magnificent picture of the complex but orderly universe in which he lives. The facts he has discovered are established by repeated test and are open to confirmation at the hands of all, standing dependable and sure as a firm island of certainty in the great sea of doubt. By no other means can there be gained so unequivocal and reassuring a picture of the truth. Uncertainty may trouble the student of esthetics or ethics as his standards undergo their periodic fluctuations but not the scientist, once his facts are known. Whether a work of art is beautiful or not, may be debated endlessly, but that $E = mc^2$, Einstein's great generalization, is not a matter of opinion any more. It is established Existentialism and neo-orthodoxy may dispute about the nature and destiny of man, but the nature of the atoms of hydrogen and oxygen and their destiny to form a molecule of water when brought together under proper conditions are not subject to argument. Scientific knowledge, to be sure, is constantly advancing and sometimes well-founded principles are overthrown, as happened in physics a generation since; but the debate in all such cases is soon settled by the keen weapons of logic and experiment without regard to preference or to authority.

NEED FOR OBJECTIVE AND INTELLIGENT APPROACH TO TRUTH

What yet may be accomplished by use of these fruitful methods of the sciences no one can foresee. In gaining knowledge of the universe their possibilities seem almost limitless. In those most difficult problems of all, the ones which are concerned with humanity itself, there is surely need for that same objective and intelligent approach to truth which has proved so successful elsewhere. One great hope for man lies in the application of science still more intensively to his affairs, and in the unlimited use of that free intelligence which is the glory of our race, as we endeavor still to "follow knowledge like a sinking star, beyond the utmost bound of human thought."

This is a high ideal. Man's reason has built an avenue on which the sciences will certainly continue to move out into the unknown. To many it seems the only road which it is safe to follow. But there is a wide terrain into which this newest highway of the mind can never penetrate, a country where are found the rich facts of experience—subjective, primary, immediate; our emotions, desires, purposes, values, feelings of beauty and ugliness, of right and wrong, of love and hate. These are hardly accessible to analysis by the methods of cold reason or understandable by science. "It is the Nemesis of the struggle for exactitude by the men of science," remarks a great biologist, Dr. H. S. Jennings, "that leads him to present a mutilated merely fractional account of the world as a true and complete picture." You can no more analyze these imponderables by scientific methods, says Eddington, than you can extract the square root of a sonnet. They lie along the far more ancient road which reaches back into the living stuff of which we all are made. Out of that amazing protoplasmic system upon which our conscious life is based arises this throng of reactions, instincts, attitudes, and mental patterns which often seem chaotic and without control but which form such an important part of every life. The agelong evolutionary process has molded these reactions into forms effective for survival in a world of struggle, and hence comes our jungle legacy of selfishness and lust and hate, embedded in this primal stuff, fixed by heredity, deep-seated, slow to change. In these protoplasmic patterns is to be sought the true "original sin" which so distressed our forefathers. Here dwells the tough "old Adam," the changeless core of human nature, lusty and unregenerate, a heritage which makes so difficult the building of a good society. But let us not forget that from this same deep living matrix there pour up into consciousness the passions, ecstasies, and longings which are of such significance in the lives of men. Just as intellect may rise from simple animal reason to lofty genius in the progress of the sciences, so may this other aspect of the mind ascend from beastliness to high humanity. Here are born the dreams and songs and aspirations which seem to most men such a vivid part of true reality. Hence comes the wisdom of the seers, who reach the truth by insight, not by reason. Hence rise all "thoughts beyond the reaches of our souls," the mystic ecstasy of those who once "on honey dew have fed and drunk the milk of Paradise."

This still is undiscovered country for the scientist. As a human being he may love the arts, be moved by poetry, be a man of faith. But in his laboratory hours he cannot help but feel that all these things, delightful though they be, are nothing at the last but sheer illusion; that they have no independent meaning of their own but float, mere epiphenomena, upon a solid basis of material stuff which must obey the laws that govern all the physical world. Our brain cells, after all, he says, are nothing but chemical systems, unthinkably complex but fundamentally no different from other mechanisms. The feelings and emotions and desires which seem to us so vivid are simply the concomitants of physical events within the brain. This psychophysical parallelism may still be an enigma, but surely its material aspect must be its fundamental one. How differentiate, he asks, between the poet's dream and that which comes from hashish or from opium? Has not the noblest of emotions, mother love, been shown to be dependent on a specific hormone? Are not conscience and conviction of sin diseases, so to speak, of the brain's frontal lobes and curable by severing these structures from the rest? Are what we so naively call our souls anything more than the ephemeral activities of integrated protoplasmic systems?

So runs the argument. Whatever is not quantitative, subject to reason, logic and experiment, cannot be part of any ultimate reality. The intangibles may often seem important but they still are only stuff that dreams are made of, the panoply of fairyland that vanishes when reason wakes, and no firm basis for sound understanding.

SCIENCE AND INTUITIVE UNDERSTANDING

Here, then, is posed the real antithesis between our two philosophies. May a true knowledge of reality be reached only by traveling the road of reason and of science? Or may it also be approached along the old and very different pathway of direct intuitive understanding, the pathway of the poets and the seers? Is this approach intellectually respectable or does it come only from desperately wishful thinking in a world which should outgrow such childish fantasies? What hope is there that *both* are valid avenues and that men who travel them can join their forces in the search for truth?

Whatever one may think of the significance of feelings, emotions, value judgments, and such workings of the human spirit, they constitute a vivid part of life. What can be said for the validity of the testimony they present, of this direct intuitive approach to truth? Are the sure sense of freedom, the love of beauty, the aspirations to virtue and good will simply illusion and the result of chance conditioning, or do these feelings offer a reliable report of something deeper, of a truth upon which may be built that high philosophy of life which is our heritage in the humanities? Are they worthy of serious study and concern? Upon the answer which man makes to these deep questions will depend at last what sort of man he is and what the world is like which he will build.

No answer of a comfortable definiteness can be given to these questions now, but it is significant that in recent years there has been evident a shift away from the dogmatic certainty of the more naively materialistic philosophies to a more open-minded attitude.

There are perhaps two major reasons for this change. First, introspection has again come into good repute. That hard-headed attitude which admitted nothing about mind that could not be observed and measured from the outside has mellowed somewhat and will recognize the cogency of subjective evidence, as well. Most of what biologists record of life comes, of course, from objective study of living things in field or laboratory; but the biologist himself is such a living thing, and the privileged position he thus holds enables him to gain experience of life from the inside, vividly, directly, and thus to know more intimately what it is than any scalpel ever can reveal. Biology hardly knows as yet what it should do with these immediate data of experience and for the most part has neglected them, since they are scarcely subject to analysis by scientific means; but they may yet provide important clues to an understanding of the true form and pressure of all life. Is it not reasonable to expect that this inner and most immediate contact with the material world which we thus make by virtue of the fact that we ourselves are protoplasmic systems, composed of matter in a constant state of change, will yield us knowledge of reality as valuable as that which reason gives, though greatly different in its character? No scientific theory or conclusion can have the direct and unchallengeable authority that experience possesses. Our sense of freedom, choice and purpose is so vivid and convincing that it often outweighs the coldly scientific conclusion that such things cannot be in a deterministic universe, a conclusion which for many, however august its origin may be, requires too great a sacrifice of common sense to logic. The throng of impulses and desires and convictions which well up into consciousness from that still obscure region where life, matter, and energy are so inextricably bound together offer impressive testimony which cannot be lightly brushed aside. If science ultimately is unable to explain such facts as these it cannot claim to be the sole interpreter of reality.

A second cause to hesitate today in accepting too rigidly materialistic a philosophy is the remarkable change which has come over the physical sciences since the century's turn. The good old days of billiard-ball atoms, Euclidean geometry and the indestructibility of matter are now gone. Materialism persists, but it is based upon a matter far more tenuous than the simple stuff on which the previous century built its confident theories. Matter in the old sense indeed has ceased to be and is replaced by a fantastic system of electrical charges, quanta, and space strains which are literally inconceivable and are open to analysis only by mathematical subtleties. The universe in which our fathers felt so comfortably at home has vanished. Although biologists and psychologists, beginning to experience the delight of dealing with life directly in terms of physics and chemistry, still are inclined to think in simpler and more dogmatic terms, the physical scientists, as one who reads DeNoüy, Eddington, Schrödinger, and many others will agree, are far less certain of the validity of the naive materialism of a generation past. As Herbert Muller puts it, "the physicists have arrived at more satisfactory interpretations of experimental facts by scrapping self-evident truths, breaking the laws of thought—by a systematic exploitation, as it were, of the nonsense which the eighteenth century had triumphantly eliminated." No longer can one say, as Renan did not so many years ago, "Today there are no more mysteries." Whether we like to admit it or not, things are more mysterious than they used to be, a century of science notwithstanding. The plot of the great epic of the universe grows deeper with each new page we turn, and how it will conclude, what great catharsis will gather all its threads once more together, the wisest cannot say. Great things are in the air, exciting new ideas in the sciences which may still further modify our understanding of the universe. This is no day to be dogmatic or complacent. The idealist who follows the ancient highway of the spirit toward reality has gained a more respectful audience than was his a half a century ago, serious men who look to him now for something more than pleasant fairy tales.

THE WHOLE MAN MUST CULTIVATE MIND AND SPIRIT

It may seem strange to some of you, perhaps, that from a man of science, and on an occasion like the present one, should come a suggestion to look with favor upon other means to reach the truth than through the carefully guarded pathway of scientific observation, experiment, and proof. Such a plea will doubtless appear to many mere reactionary obscurantism and self-delusion. But I certainly do not seek to lessen the regard we all must have for science as interpreter and guide. Whenever it speaks clearly we must follow it. The surest way to chaos in a modern world is to check its development or veto its conclusions. A spirit which would put a moratorium on research or lock up scientific truth, doling out that part which it approves and forbidding knowledge of the rest, leads only to disaster. My plea is to push on in science with the utmost vigor and enthusiasm we possess but also to admit that there are many aspects of reality with which it evidently cannot deal, matters of the utmost moment to mankind if he is to build that Good Society which all of us in these dark days so ardently desire. In the confusion and uncertainty which beset the world we may be tempted to fall back upon the simple philosophy of materialism which has proved so serviceable in the sciences and is supported by their great prestige, and to scoff at those well-meaning but softheaded fellows who believe that there is another avenue to truth. I urge the recognition of this other avenue and its diligent exploration. Around it have grown up the great tradition of the arts, the humanities, and the religions, the ideals of freedom and of good will and of the worth of man. Even in an age of science these ideas and values, I believe, are not only intellectually respectable but must be cultivated vigorously if our civilization is to live. Man leads a double life, of mind and spirit. If mind is suspect, as in religious fanaticism, he may become a creature only of his instincts and emotions; if spirit is suspect, as today when scientific materialism carries such authority, he is in danger of degenerating into a selfish and soulless mechanism. To be a whole man he must cultivate both parts of him.

Never in history has this been needed so desperately as today. Our world is out of joint. The crisis which confronts it is no ordinary one, but puts in peril not only civilization but the very existence of our race on earth. This crisis has arisen from the fact that intellectual achievement, as expressed in the progress of the sciences, is cumulative and has thus been able to outrun the moral and esthetic qualities of man. These, so closely involved with instinct and so near the purely biological level, are hard to change. Since they lack standards which are fixed and demonstrable, progress is at best uncertain and impermanent here, and a single generation may lose all an age has gained. Man's control over the forces of the material world has grown to be far greater than his mastery of himself. No mere advance in intellectual power is going to meet this danger. No social mechanism, no economic system can save us now. To direct all science solely to the service of society, as some would have us do, will not suffice. Not unless man himself can be improved, can be exalted far above the beast he was, can any social order now survive. Whether we relish it or not, here we must deal with spirit as well as mind. A great scientist and thinker of today, President Conant of Harvard, points out how rarely in our daily lives we are influenced by the results of modern science, but how often we reflect in our acts the philosophy and poetry we have imbibed over many years. "A dictator," he says, "wishing to mold the thoughts and actions of a literate people could afford to leave the scientists and scholars alone, but he must win over to his side or destroy the philosophers, the writers, and the artists." Let us face the fact that what the world must have is a fuller cultivation of these spiritual qualities of man. Whatever we may think about their origin, as scientists we should no longer sneer at or ignore them, for on their strength depends our own survival. There is something in them which is deeper than intellect and rises from within, little subject to reason or to logic. Unless these inner forces can be tamed and cultivated till they will help guide our course, we shall destroy ourselves.

HOW CAN DISCIPLINES OF MIND AND SPIRIT BE BROUGHT TOGETHER?

Such is the argument to which we have addressed ourselves this afternoon. If one now grants the vital necessity of bringing together these two great disciplines of mind and spirit, the sciences and the humanities, how best can it be accomplished? This surely is a major task for education and here chiefly we must look to our great colleges and universities to meet the problem. In them have long been nourished the humanities and in them science is advanced for its own sake and not alone for its applications in technology. Here students may be introduced to both and shown how each can supplement the other in the education of the whole man.

To do this well, however, is no simple matter. It involves much more than course requirements and proper balancing of curricula. The sciences and the humanities must not be taught as separate disciplines, but as the two main aspects of a broad liberal training, and we must emphasize the many qualities they have in common. Logic and reason are no monopoly of science, nor is creative intuition limited to practitioners of the arts. Indeed, the ways in which the scientist and the poet work are very similar, as Dr. Cannon shows in his delightful essay on the role of intuition in research. The feeling of something just around the corner, the working of subconsciousness which suddenly brings up, and often at strange times, the answer to a question pondered long and fruitlessly—these are common to both. The ardor and excitement, too, of the investigator as he adventures into the unknown and finds at last some new relationship which lets him see more deeply into nature, this is companion to the creative ecstasy which moves the artist's soul. He who explores the universe through telescope or microscope is spiritual brother to the poet who looks out "through magic casements opening on the foam of perilous seas, in faery lands forlorn." And, finally, we should not forget that though the great faiths of the world have been nourished by spirit, the deepest of all faiths—that in an orderly and dependable universe—is the fundamental postulate of every science. Belief in something constant and unchangeable, call it by whatever name we will, is a necessity not only for religion but equally for science and the arts and forms a common meeting ground and starting point for men who travel on the highway of the mind and those who use the road of the spirit.

Such is the grave mandate of our universities. Never in history have they been called upon to render service to humanity as great as this. Man, not matter, is the chief problem of the world today. If we train his mind to master material things without at the same time enlarging his spirit so that he may appreciate the value of immaterial ones and thus become the master of himself, he is but half a man. The greatest peril now is not from lack of education but from one-sided partly educated men. Only whole men can save the world today and to train them well is the imperative task of every university.

Upon our men of science is the chief burden laid. Science is modern, popular, and dominant. It needs no special pleaders,

(*Continued on page 142*)

RESEARCH *on* RUBBER *for* MECHANICAL ENGINEERS

By J. F. DOWNIE SMITH[1]

RESEARCH SECRETARY, RUBBER AND PLASTICS DIVISION, ASME

DURING the past fifteen years, considerable progress has been made in the understanding of rubber and its uses by mechanical engineers interested in the subject. A much clearer idea of the material and its possibilities has resulted from papers presented within the past decade before technical societies. A great amount of research, however, still has to be done and presented to the engineering profession before the engineer can design with confidence many of the more common rubber products. On the other hand, some of the information necessary for design has already been obtained by research workers, and either kept in company files or published in a magazine not ordinarily read by mechanical engineers. In many such cases, the requisite information is not available to the engineer.

Hence, one of the purposes of this paper is to stimulate research on rubber and rubberlike materials either in the laboratories of industrial organizations or in technical colleges. Another is to encourage publication in mechanical engineering journals of material already available which would interest mechanical engineers.

The design of some rubber articles calls for no great amount of technical design information, but in certain cases such data are necessary. Perhaps the most common article of this category is the rubber spring. This paper is mainly concerned with rubber for use in springs or mountings, but many questions have been raised for other applications.

APPLICATION OF RUBBER TO SPRINGS AND MOUNTINGS

In reading this report it may appear to some that more emphasis should be placed on dynamic rather than on static tests. It seems to the author, however, that a clear understanding of the static phenomena is necessary before going on to the more complicated dynamic problems. Thus, the program is definitely incomplete, and may later have to be expanded. Also, since every engineer has not been approached, all problems could not possibly have been unearthed. However, many men have been consulted on the problems each has in this field; men who are from most of the basic engineering divisions.

Furthermore, the data were accumulated several years ago, and since then some of the material probably has been made available. With the help of representatives from the rubber industry, the author has tried to bring the report up to date. The several references cited are only those of the past few years. No attempt has been made to obtain a complete bibliography. In many cases references to work in a special field are admittedly incomplete, but the references cited give typical data. No slight is intended toward authors not listed in the Bibliography at the end of the paper.

It is realized that many of the problems mentioned are of a specialized nature, and perhaps research on those could not be justified at this time. Thus, if the program is acceptable on the whole, some priority in treatment of the individual items could be set up in conference between representatives of the rubber industry, mechanical engineers, and others interested. What appears important to a particular engineer may cover such a small percentage of the output of the rubber industries that they would not be interested in carrying on the necessary research. At such a conference a plan of procedure could be prepared and particular phases set aside for immediate analysis, others for the near future, still others for the distant future, and some completely discarded.

Those problems to be given immediate attention could be studied to determine if they were more suitable for an industrial laboratory or a technical college. Several colleges would be willing to consider such a research program if suitable financial backing could be obtained.

Among the items still unknown to the average mechanical engineer not in the rubber field are the following:

A STRESS-STRAIN RELATIONSHIPS

1 There is considerable uncertainty regarding the limits of stress to which we can subject rubber successfully for long service. Widely varying recommendations are given by the large rubber manufacturing companies, and agreement should be reached regarding the safe working loads for rubber loaded in shear, compression, and tension. Recently, variations in shear stress of 3 to 1 have been obtained from two different companies (both large and well considered) given the same specifications.

One school of thought would rather put limits on strain and let the stress fall where it may. One recommended value is to limit strain to 20 per cent for application in shear and compression. Another group considers this much too conservative.

2 The bond strength between rubber or synthetic rubberlike materials and the various metals, alloys, and plastics used in industry should be available to engineers. Of these metals, perhaps the most important are the following: Steels of various compositions; stainless steel; aluminum and its alloys; and brass. It is realized that bond strengths are improving and that a year from now present values may be too low; however, for the guidance of the engineer, values which can be obtained satisfactorily today should be correlated for rubberlike materials, presently in use, and presented simply in the engineering literature.

Some information on this subject is already available (1, 2, 3, 4, 5, 6, 7, 8).[2]

3 Chrysler's "Cycle-Weld" process can be used to vulcanize two pieces of synthetic rubberlike material together so that the bond is strong. Also, U. S. Plywood has developed adhesives of the "Plio-Bond" type. What other processes, if any, are available commercially?

---

[1] Dean of Engineering, Iowa State College; Director of the Iowa Engineering Experiment Station, and Director of the Engineering Extension Service.

Contributed by the Rubber and Plastics Division of The American Society of Mechanical Engineers.

[2] Numbers in parentheses refer to the Bibliography at the end of the paper.

4 It would be of interest to have further data on the variation of the several physical properties with variations in the compression and shear moduli. It is realized that one of the principal objectives in compounding is to change the physical properties, within limits, of the vulcanizates, and thus unique solutions are not expected. However, representative data would be welcomed.

The engineer not too familiar with rubber has a tendency to identify hardness with modulus of elasticity, for reasons of convenience in measuring tools. Possibly, this should be discouraged.

A valuable paper is available on this subject (9).

5 The effect on the stress-strain relationships for rubber, loaded at several different temperatures, has been investigated (7, 9, 10, 11, 12, 13, 32, 33, 49).

There seems to be a feeling that it is not feasible to correlate Shore type-A durometer hardness with any of the elastic properties of vulcanizates.

Is it true that there is little effect on flex life within the temperature range ordinarily met in practice?

6 In what way and to what extent does the variation in compound affect the hysteresis loop obtained from several different types of loading; both static and dynamic? An excellent treatise on the subject is given in (51). A few other data are available on this subject (9, 50).

7 A knowledge of certain definite characteristics of extruded rubber and rubberlike materials is necessary. Among the characteristics desired are tensile strength, tear resistance, permanent set, abrasion resistance, and the effect of exposure.

The author has been informed that, from the practical standpoint, there is little difference in the physical properties of the vulcanizates resulting from an extruded or molded item. He has had quite marked differences and results from compression-molded and transfer-molded processes.

8 Two different types of sponge rubber are available commercially today. One has interconnected cells and the other has not. It would be of interest to the engineer to know the essential difference between the two; how he could determine the spring constants of either; what absorption of sound or vibration would be expected from them; their creep under compression; the rapidity with which they would deteriorate, and their adaptability for use as gasket materials. Some information on this subject was presented by the United States Rubber Company before this Society, at a meeting in New York in November, 1945. Additional information is available in references (7, 34, 35).

9 Stress-strain curves should be charted for rectangular slabs showing the effect of the unstressed slab angle θ in Fig. 1. This would involve a series of tests of rubber of definite hardness, loading-surface dimensions, and slab height, with definite angles. A similar series could be performed with a constant angle θ, constant rubber hardness, and surface area, but with varying slab heights.

The purpose of this experimental work is clear. There are many cases in industry where the designer is confronted with the compression of shear pads, and the problem is just as outlined.

Some information on this subject has been presented in bulletin form by the United States Rubber Company and also in references (7, 14, 15).

10 Stress-strain curves should be obtained for both shear and compression in the case shown in Fig. 2 for several angles θ varying from 0 deg to 90 deg. The tests should include distinct series of tests with each series varying only one factor at a time. The factors to be varied are height, loading-surface dimensions, hardness of rubber, and angle θ. Some commercial bulletins are available by the Lord Manufacturing Company, General Tire and Rubber Company, the Korfund Company, Inc., and others, which give information on this subect. Also, a single test is reported in (15).

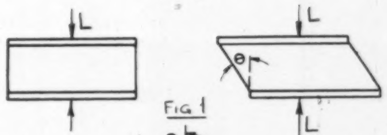


Fig 1

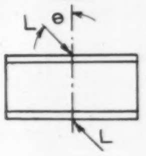


Fig 2

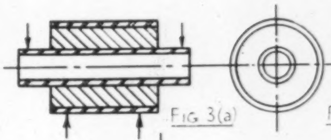


Fig 3(a)

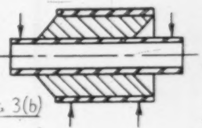


Fig 3(b)

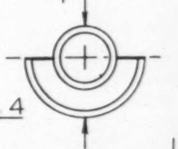


Fig 4

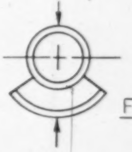


Fig 5

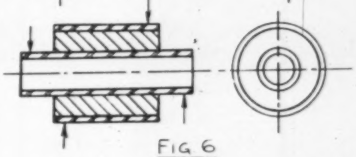


Fig 6

11 Load-deflection curves should be obtained for several cylindrical bushings of the types shown in Fig. 3(*a* and *b*). Again, all factors which would have an influence on these curves should be investigated separately. This particular problem is of importance where rubber torsion bushings are to be designed with no external supports to keep the metal cylinders concentric.

The author has quite inadequate information on this subject, but he has presented some in (15).

12 In line with Section 11, it would be of interest to conduct a similar series of tests where rubber is not a complete cylinder. Figs. 4 and 5 show the type of loading which at times could be employed advantageously, but at the moment difficulty is experienced in the proper proportioning of the bushings to take definite loads. A limited series of tests is given in (15).

13 Upon occasion cylindrical bushings of the type discussed in Section 12 would be subjected to a twisting action as shown in Fig. 6. Very few data are available under such conditions. Again, several series of tests should be made to determine the effect of each variable. One test is described in (15).

14 In Fig. 4 cylinders were considered. If the inner cylinder were replaced by a sphere and the outer cylinder by a hemisphere a similar series of tests could be performed.

In all of the cases mentioned in Sections 9 to 14, the tests should be performed with the rubber bonded to the metal and repeated without such bonding.

Probably some data are already available on these matters in the files of the various rubber companies.

15 It is possible to get a reasonable check between theory and experiment for shear loading of rubber; e.g., see (42, 43, 47, 48). In so far as the author is aware, however, no theoretical equation is available which would give the relationship between compression load and deflection for the case where the metal is bonded to the rubber. Such an equation, if it is not too complicated, would be of great value to the engineer.

16 If no theoretical equation for compression can be found, it would be extremely helpful if the engineer could get complete stress-strain curves for the entire range of rubber for various loading areas and slab heights. In addition, the effect of shape should be investigated. Some attempts have been made in the literature to correlate such data (7, 14, 31, 42, 43, 44, 45, 46). In general, however, conclusions based on more extensive data would be welcomed.

Some companies advocate that the engineer should work in the region of shear and compression loading where the load-deflection curve is straight. To the average engineer this is an undesirable limitation on the use of rubber for springs.

B TEMPERATURE EFFECTS

1 A few scattered data have been published in the literature showing the effect of temperature on rubber hardness, generally giving only the extreme temperature limits of the test. A much more comprehensive series of tests should be made showing the influence of temperature on rubber hardness for a wide range in temperature and rubber composition.

A creditable start has been recently made and some information is available in references (7, 10, 12, 16, 49, 50).

For all cases of compression, tension, and shear, it would be interesting to know the effect of temperature on the stress-strain curves. Such an investigation should be performed under accurately controlled conditions.

Some data on tension are shown in (7) and (9), and additional tests are under way at the laboratory of E. I. du Pont de Nemours and Company.

3 Under specified loading conditions as, for example, 50 psi in shear, the influence of temperature on creep of the rubber should be obtained. This, naturally, would involve many different rubber compositions and hardnesses.

It is the author's understanding that the U. S. Rubber Company and the Lord Manufacturing Company have done some work on this. It has also been suggested that strain be substituted for stress for these tests; see also (36) and (50).

4 Comparatively few data have been published in the mechanical engineering magazines on the thermal conductivity of rubber of various compositions. This is of interest to the engineer because of the heat generated in the rubber during the working cycle. Rubber has a relatively high hysteresis loss and comparatively low thermal conductivity. Thus, if the amplitude of vibration is large, and the frequency rapid, it is possible to build up inside the rubber temperatures which would make it deteriorate rapidly. Under extreme cases, rubber subjected to severe vibration smokes in a few minutes. It is entirely possible that a theoretical analysis for the heat conduction could be worked out, provided the hysteresis curve under working conditions could be obtained. Since this hysteresis curve may change with conditions, it would be desirable to obtain experimental data on the heating of rubber under varying conditions of amplitude, frequency, and rubber composition.

The composition of the vulcanizate and the state of vulcanization are both important. In general it may be stated that thermal conductivity varies little with variation in materials. A vulcanized neoprene type GN similar to a tire tread has a thermal conductivity of about 0.121 Btu per hr per sq ft per deg F per ft, whereas a vulcanized rubber similar to a tire tread has a thermal conductivity of about 0.094 (same units). Some data are given in (31).

5 The coefficient of thermal expansion for several rubber compositions should be available to the mechanical engineer for various temperatures. Where rubber is relatively closely confined, an indication of the pressure built up by the rubber on the external members would be of interest.

Some information has been published (17, 31). There has been also a belief that the U. S. Rubber Company has done work on determining the pressure built up by the rubber when closely confined.

6 If rubber is to be loaded in shear, it is common practice to apply to the rubber a compression load which varies from a small amount to as much as 150 psi in extreme cases. A fairly common value is 50 psi. Now if, at a definite temperature, a compression of 50 psi is applied and the external framework is so rigid in this position that it will not permit the rubber to move in the direction of compression, what would be the pressure at several other temperatures? This, again, would involve an investigation of several loading-surface areas, thickness of the pieces under test, and rubber compounds of all sorts.

7 The variation in specific gravity for many rubber compositions with temperature variations should be tabulated. This, of course, is only another way of requesting volume-temperature data for several rubber compositions.

8 A study of the Joule effect, i.e., changes in deformation of stressed rubber with changes in temperature, might well be studied further. This is distinct from the effect of temperature on the modulus as ordinarily understood in engineering use, and is important for rubber springs for vehicles; see (31) for a few data.

C CREEP AND PERMANENT SET

1 In the literature some data are availableshowing the creep of rubber compounds for reasonable periods of time. Further data of this type for many compounds at several different temperatures would be helpful. These data should be obtained for shear, compression, and tension of rubber.

Among the available articles are (9, 18, 19, 20, 21, 22, 32, 33, 43, 49).

2 If various rubber compounds, all of the same durometer hardness, are subjected to loads for a long period of time, what limits of cold flow would be expected?

These, it is realized, would depend upon the state of vulcanization, and perhaps upon other factors. An excellent start is given in (9).

3 What connection is there between creep and permanent set after removal of load? Some information is available in (22).

4 Similar data for sponge rubber would be of interest.

D DEALING WITH THE DUROMETER

1 Wider publicity should be given to the standardization procedure for the use of a durometer recommended by the American Society for Testing Materials (ASTM-D676-44T). A committee composed of rubber technologists and engineers has agreed that the Shore type-A durometer should only be used as a means of classifying vulcanizates roughly, and not as a test instrument (ASTM-D735-43T). Many engineers accept the readings of their durometers as something indisputable. The only hardness instrument recognized by A.S.T.M. is the A.S.T.M. hardness tester (ASTM-D314-39).

2 It would be of interest to know if the hysteresis characteristics of the rubber can be tied in with the durometer hardness number or with the modulus in any way. At the present time, it is not generally known whether this is even possible.

3 What are the limits of deflection obtainable for different compounds all of the same durometer hardness, or of the same modulus. Various statements have been made that the limits will be quite far apart. The engineer would like to know how far apart they are.

4 Is there any definite relationship between the durometer hardness and the physical characteristics of rubber of different compounds? There seems to be a general belief that there is no such relationship. The engineer would like to be sure.

5 If such a curve based on the Shore durometer hardness

does not give a satisfactory result, the engineer would like recommendations regarding the development of any new instrument which would give him what he wants. It is understood that the ASTM is actively studying this problem.

6 What limits in hardness on the durometer scale or as a modulus of elasticity can be obtained satisfactorily? In particular, what limits should be set for the various fields of application of rubber and rubberlike materials? These limits should consider also the various forms in which rubber can be obtained; that is, in strip, sheet, or extruded form.

E DYNAMIC CHARACTERISTICS

1 Under a quickly applied load the stiffness of a rubber spring appears to be greater than one would expect from the static-load-deflection diagram. Some investigations have been started to find out what increase is to be expected for the dynamic over the static stress-strain curve. In some applications the ratio seems to be as great as 2 to 1. A general study of this subject would be valuable. Some information may be obtained from references (9, 22, 23, 24).

For rubber compounds ordinarily met in practice, the dynamic modulus may perhaps be 10 per cent higher than the static modulus, but, for certain synthetic rubberlike materials, the ratio of the two moduli may be 10 to 1.

2 In line with the preceding item, it would be desirable to have the dynamic hysteresis characteristics of basic rubber stocks presented as a function of percentage deflection and frequency, or of the state of vulcanization, if this is more important.

3 We should know the effect of the frequency of a vibration of given amplitude on the hysteresis characteristics of rubber. We should also know whether the losses per cycle remain constant or vary with the frequency, or with the state of vulcanization.

4 It would be of interest to know the ability of rubber to absorb either vibration or sound of different frequencies and amplitudes. Some data of a specialized nature are available (25, 43).

F WRITING SPECIFICATIONS FOR RUBBER AND RUBBERLIKE MATERIALS

1 The engineer would like to have at his disposal a fairly extensive set of standard specifications for rubber stocks similar to the S.A.E. specifications for steel. The Society of Automotive Engineers and the American Society for Testing Materials have both worked on this problem, and some data are available in (37, 38, 39, 40). It is felt that these are not extensive enough.

2 It would be desirable for the industry to come to some agreement on a standard set of physical tests for the various applications. In general the ASTM-D735-43T serves as a guide.

3 In order to insure duplication of the mechanical characteristics of certain parts, the engineer would like to know what physical specifications are necessary in order to identify definitely the product even though it may be secured from several different companies. It has been suggested that proper specifications would include static and dynamic modulus and set characteristics.

4 With the various instruments in use today for rubber testing, there seem to be no specified limits of tolerance which can be laid down by the engineer. For example, if he has to design a spring with a durometer hardness number of 45, how closely can he expect to get to this value if the rubber manufacturer uses (*a*) ordinary care, (*b*) great care?

At the present time the tolerances permitted by the engineer are large, and can be reduced. It is clear, of course, that the greater the care exercised the higher the cost of the rubber product, so that some judgment has to be exercised in the matter.

Unfortunately, all durometers available commercially today do not read alike. Under the circumstances, would it not be better to specify the modulus of elasticity in shear, with suitable tolerances, for the rubber? Since this paper deals largely with spring material, and modulus of elasticity in shear is really what is needed in the calculations, this seems logical.

5 What ranges in thickness of rubber or rubberlike materials can be obtained commercially?

G TESTING MATERIALS FOR ACCEPTABILITY

1 When rubber has been ordered and received, the question arises whether or not it is satisfactory. Testing procedure to make sure that rubber does meet the specifications set down should be standardized. Among the factors involved would be a method of inspection for the low cold-flow properties of the rubber. It is realized that it might be a difficult matter to test for creep in a few minutes or hours, but after installation it is too late in some cases to make such tests. It may be possible to devise an overload test which would give an indication in perhaps a day's time of what might be expected of rubber at lower rates over a longer period of time. The limitations of creep which would be permitted can be specified beforehand.

It has been stated that permanent set or compression set, working within the straight-line portion of the load-deflection curve, is in general a fair indication of the creep characteristics of the vulcanizate and also the state of cure, which is a large factor in the acceptability of the product. Is this good enough?

2 The engineer in general is not familiar with such items as the minimum dimensions of rubber to get satisfactory hardness readings, or what is a permissible drop in durometer reading during the determination of hardness. The ASTM Standards on Rubber Products, (D676-44T), might be reproduced in mechanical-engineering publications perhaps in modified form, and amplified to contain a more recent acceptable test procedure, if any.

H WEATHER RESISTANCE

1 What is the influence on rubber and rubberlike materials of the following:

(*a*) Light, particularly as it affects cracking?
(*b*) Climatic changes?
(*c*) Aging?
(*d*) Special climates?

Some material covering these items is already available (7, 9, 26, 27, 28).

2 What is the effect on rubbery materials of exposure to quite extreme temperature conditions for extended periods? In other words, how do the physical properties change? These temperatures should be taken from —35 F to 350 F.

Some excellent articles are available, including references (9, 10, 11, 12, 13).

I CHEMICAL RESISTANCE

1 The resistance of each of the rubbery materials to various commonly used liquids should be tabulated in an easily understood manner. Among the liquids should be mentioned particularly lubricating oils, gasolines, both low and high test, hydrocarbons generally, water, common acids, etc.

The influence of temperature on this resistance should also be noted.

In such a tabulation the durometer hardness should be given. A good start has been made in references (9, 29, 30, 43, 50).

2 It seems to be feasible to vulcanize on the outer surface of a rubber spring a synthetic material like neoprene to give better resistance to sunlight, ozone, oil fumes, etc. Does anyone have serious objection to this?

Comparative data of the various protective coatings should be listed.

3 Corrosion is caused by some of the rubbery materials on the common metals, including aluminum alloys, magnesium, and steel? The engineer should be given some details on this so that he would be amply warned in case of potential trouble.

J ABRASION RESISTANCE

1 In certain fields, like the automobile industry, it is desirable to know how to specify the material for such articles as floor mats, clutch, brake and accelerator pedals, so that they will have a predetermined abrasion resistance. In addition, is there a simple accelerated test to determine the acceptability of the goods?

K GASKETS

1 A gasket is ordinarily applied between two metallic plates. Naturally a permanent set will be acquired when sufficient pressure is applied to the rubberlike material. For several operating pressures it would be desirable to know how much permanent set could be expected. The repeated tightening of the gasket every few days is annoying.

If the gasket material is properly chosen, is repeated tightening still necessary? Some information is available in reference (41).

2 Can neoprene or other oil-resistant material be used for gaskets with pressures from 5000 to 10,000 psi? Such gaskets would, of course, have to be restrained on the inside or the outside diameter and partially restrained on the other diameter. If such pressures can be maintained, what are the limits to the several ratios such as length and diameter?

Certain synthetic rubberlike materials have already been applied successfully for aircraft seals with pressures up to 3000 psi.

3 In certain fields it is of interest to know the compressibility of various grades of rubber of several different hardnesses on the durometer scale. Similar information should be obtained for several rubber and rubberlike products.

ACKNOWLEDGMENTS

The author has been in touch with a great many mechanical engineers and representatives of the rubber manufacturing companies and he is grateful to all those who have contributed to this compilation. In particular, however, he would like to express his appreciation for the help given by W. Newlin Keen, D. H. Cornell, J. W. Liska, S. D. Gehman, and F. L. Yerzley.

BIBLIOGRAPHY

1 "Adhesion of Neoprene to Metal," by F. L. Yerzley, *Industrial and Engineering Chemistry*, vol. 31, 1939, p. 950.

2 "Brass Plating for Rubber to Metal Adhesion," *Steel*, December, 1945.

3 "Bonding Rubber to Metal," by M. Farberow and collaborators, . Ind., U.S.S.R., 1936, p. 900.

4 "Rubber Bonding to Metal," by C. M. Blow and G. Hopkins, *Journal of the Society of Chemical Industry*, vol. 64, Nov., 1945, p. 316.

5 "The TyPlys," R. T. Vanderbilt Company, New York, N. Y.

6 "Cycle-Weld Process," Chrysler Corporation, Detroit, Mich.

7 "Rubber in Engineering," The Services Rubber Investigations, Ministry of Supply, Ministry of Aircraft Production, March, 1945.

8 SAE-ASTM Committee work on engine mountings, and others.

9 "Synthetic Rubber Mechanical Parts in Present and Postwar Vehicles," by E. F. Riesing, presented before the S.A.E. in Detroit, Mich., Jan. 8–12, 1945.

10 "Effects of Low Temperatures on Neoprene Vulcanizates," by F. L. Yerzley and D. F. Fraser, *Industrial and Engineering Chemistry*, March, 1942.

11 "Some Relations Between Stress, Strain, and Temperature in a Pure-Gum Vulcanizate of GR-S Synthetic Rubber," by Frank L. Roth, and L. A. Wood, *Journal of Applied Physics*, November, 1944.

12 "Effect of Low Temperatures on Young's Modulus of Elastomers," by J. W. Liska, *Industrial and Engineering Chemistry*, vol. 15, January, 1944.

13 "Some Low-Temperature Properties of Elastomers," by J. W. Liska and F. S. Conant, *Journal of Applied Physics*, vol. 15, November, 1944, p. 767.

14 "Rubber Springs," by W. C. Keys, MECHANICAL ENGINEERING, vol. 59, May, 1937.

15 "Rubber Springs Under Compression Loading," by J. F. Downie Smith, MECHANICAL ENGINEERING, vol. 63, April, 1941, pp. 273–277.

16 "Effects of Elastomer Crystallization on Tests for Freeze Resistance," by D. B. Forman, *Industrial and Engineering Chemistry*, vol. 36, August, 1944, p. 738.

17 "Forms of Rubber as Indicated by Temperature-Volume Relationship," by Norman Bekkedahl, *Journal of Research*, National Bureau of Standards, vol. 13, Res. paper RP-717, Sept., 1934.

18 "Creep of Neoprene in Shear," by F. L. Yerzley, MECHANICAL ENGINEERING, vol. 63, 1941, p. 343.

19 "Stress Relaxation of Natural and Synthetic Rubber Stocks," by A. V. Tobolsky, L. B. Prettyman, and J. H. Dillon, *Journal of Applied Physics*, April, 1944.

20 "Drift and Relaxation of Rubber," by M. Mooney, W. E. Wolstenholme, and D. S. Villars, *Journal of Applied Physics*, April, 1944.

21 "The Creep of Natural and Synthetic Rubber Compounds in Shear," by S. H. Hahn and I. Gazdik, *India Rubber World*, 1941, p. 51.

22 "The Creep of Neoprene in Shear Under Static Conditions," by W. N. Keen, presented before the A.S.M.E. in November, 1945.

23 "Neoprene as a Spring Material," by F. L. Yerzley, Trans. A.S.M.E., vol. 62, July, 1940.

24 "Static and Dynamic Properties of Rubber Under Compression," by C. W. Kosten, Proceedings of the Rubber Technology Conference, London, England, 1938, paper no. 59, pp. 97–102.

25 Korfund Company, Inc., Long Island City, N. Y., catalog G-100.

26 "Heat Resistance of Neoprene GN Vulcanizates," by D. B. Forman, *Industrial and Engineering Chemistry*, vol. 35, Sept., 1943, p. 352.

27 "Heat Resistance of GR-S," by B. M. Sturgis, A. A. Baum, and J. R. Vincent, *Industrial and Engineering Chemistry*, April, 1944, p. 348.

28 du Pont's formal bulletin—"The Limitations of Rubber,"—38-1, 38-2.

29 "The Chemical Resistance of Rubber as an Engineering Material," by H. E. Fritz and J. R. Hoover, A.S.T.M. Symposium on Rubber, March 9, 1932.

30 "The Effect of Petroleum Products on Neoprene Vulcanizates," by D. F. Fraser (part 1, Kerosene; part 2, Lubricating Oils; part 3, Gasolines), *Industrial and Engineering Chemistry*, vol. 32, March, 1940, p. 320; vol. 34, Nov., 1942, p. 1298, and vol. 35, Sept., 1943, p. 947.

31 "Rubber, Physical and Chemical Properties," by T. R. Dawson and B. D. Porritt, Research Assoc. of British Rubber Manufacturers.

32 Roelig, *Kautschuk*, No. 1, 1942.

33 Roelig, *Zeit. V.D.I.*, vol. 87, 1943, p. 347.

34 Kosten, Journal of the Acoustical Society, vol. 18, 1946, p. 457.

35 Kosten and Zwikker, *Physica*, vol. 4, 1937, p. 843.

36 "The Services Rubber Investigations"—Users Memorandum No. U-12, Ministry of Supplies, Berkeley Court, Glentworth Street, London, N. W., England.

37 ASTM-D735-43T.

38 SAE Handbook.

39 ASTM Symposium on Synthetic Rubber, by M. J. deFrance, March, 1944.

40 G. H. Swart, *SAE Journal*, July, 1946, p. 59.

41 ASTM Symposium on Synthetic Rubber, by Ball and Maassen, March, 1944.

42 "Rubber Mountings," by J. F. Downie Smith, *Journal of Applied Mechanics*, March, 1938, pp. A-13—A-23.

43 "Some Physical Properties of Rubber," U. S. Rubber Company Bulletin.

44 K. Oeser, Proceedings of the Rubber Technology Conference, London, England, 1938, p. 1092.

45 E. G. Kimmich, *India Rubber World*, vol. 103, 1940, 8S; *Rubber Chemistry and Technology*, vol. 14, 1941, p. 407.

46 Royal Aircraft Establishment, Report M. T. 5524.

47 "Rubber Springs—Shear Loading," by J. F. Downie Smith, *Journal of Applied Mechanics*, December, 1939.

48 "Rubber Springs—Shear Loading, Part 2," by J. F. Downie Smith, ASME Meeting in Detroit, Mich., June, 1946.

49 "Laboratory Testing of Rubber Torsion Springs," by D. H. Cornell and J. R. Beatty, ASME presentation, New York, N. Y., Dec., 1946; *The Rubber Age*, vol. 60, March, 1947, p. 679.

50 "The Evaluation of Rubber and Rubberlike Materials," by J. D. Morrow, ASME Meeting in Detroit, Mich., June, 1946.

51 "Hysteresis and Methods for Its Measurement in Rubber-Like Materials," by J. H. Dillon and S. D. Gehman, *India Rubber World*, October, November, 1946.

PRODUCTIVITY—PRICES *and* MARKETS

By ALVIN E. DODD

PRESIDENT, AMERICAN MANAGEMENT ASSOCIATION, NEW YORK, N. Y. FELLOW, ASME

ARISTOTLE, that great writer of classic times, stated that social organization comes into being for the sake of preserving life itself, but that it continues its development to promote a life directed toward better living.

Those who attended the International Management Congress at Stockholm, in July, 1947, came away doubly impressed with the view—which was the consensus of all the nationals present—that improved management is the best means by which progress toward our social and material objectives can be hastened. More has been done by the engineers of this country than by those of any other toward the fullest economic utilization of the available physical resources.

I am very proud to be the recipient of an honor set up to memorialize one of the greatest engineers of this Society—Henry Laurence Gantt—distinguished contributor in the "adaptation of engineering methods to human needs," pathbreaker in evolving "a system of management," which he described as "a means of causing people to co-operate with each other for common ends."

Gantt showed that true scientific management has at heart the interest of the employee as well as that of the employer, because it gives the former a high wage for a justly determined amount of daily output, and at the same time reduces unit costs for the latter.

Gantt was the first to demonstrate how to carry out these principles by showing that the great problem of management is one of creating spontaneous co-operation; for it is within the actively participating group that the individual experiences the assurance of personal and group security which goes so far in meeting the goals of man in industry.

In the upper echelons of management, we have achieved that particular co-operative attitude which makes for fine teamwork. Allow me to illuminate the impact of this highest form of participation among management on its social responsibilities, and the implications for the future of the American economy.

THE MONEY PRODUCT OF INDUSTRY

In production, management's basic responsibility is to combine the various factors so as to obtain the highest possible money product or national income with the least expenditure of effort. Most conducive to this goal, which encompasses increasing productivity, higher purchasing power, and ever-widening markets, has been our own free economic system. The success of our system is proved, not only by the increasing benefits it has distributed to all sectors of our economy, but by the increasing share it has allowed all sectors in determining what shall be produced.

In this system, the "consumer" is supreme. He allocates his expenditures among different products so as to derive the maximum of satisfaction. Today it is a far cry from the well-known defiance of the consumer, couched in the phrase, "The Public be damned," to the modern situation in which the consumer ruthlessly does the damning. The consumer today has $160 to $170 billion of spendable income with which he is able to exert the power of life and death over industry—to decide, in effect, which businesses shall succeed and which shall fail.

But the consumers who exercise this supreme power are not a small privileged class; they are the public itself—labor, management, the farmers, the whole population, in fact. If some of them have greater purchasing power than others they do not, for that reason, exercise an undue influence on the voting, for American business is geared to a "mass" market.

America has a mass market, not only for necessities but for luxuries. Over the last 100 years, labor's real income has increased approximately sevenfold. In the same period, leisure time for the enjoyment of the fruits of production has not remained the privilege of the few, but has become the accepted right of the many. A hundred years ago, labor's share in leisure was practically zero—since the working day was from 12 to 16 hours. Now the working day is 6 or 7 hours, with not only Sundays, but Saturdays as well, free in many cases.

The living standards of people at work have also markedly increased, reducing physical effort, unproductive idleness, human inconvenience. Widespread work simplification has meant the adjustment of the machinery and the process to the man rather than the reverse. Conservation of human resources has greatly improved through careful selection, better placement, better training, and through a multitude of benefit plans providing for accident, sickness, old age, and death.

Along with all this has gone increasing participation in actual business ownership. There are 10,000,000 direct shareholders in American companies, and 40,000,000 more indirectly contributing to the capital of industry through insurance companies and savings banks. Hence it would not be an exaggeration to call ours a genuine "people's capitalism."

The essence of the system that has produced these results has been the economic freedom of the individual, in contrast to the system of state control characterized recently in a masterly phrase by Winston Churchill as a "policy of equalizing misery and organizing scarcity." It is, instead, what he described as a system which allows "diligence, self interest, competitive selection and the infinite processes of personal ingenuity to produce abundance and to constitute the life of a free society."

In our atmosphere of economic freedom, management has so combined the factors of production as to satisfy more and more of our wants and needs, and constantly to reduce the human costs of production. The revolutionary technical changes, which have so far chiefly affected industry, are spreading to agriculture, and may soon be attacking housing. In the light of recent production advances, before many years have passed, we may be able to perform all operations with perhaps half the human effort to which we have been accustomed. Pro-

---

Acceptance address given under the auspices of the Management Division in connection with the presentation to the author of the Gantt Medal at the Annual Meeting, Atlantic City, N. J., December 1-5, 1947, of The American Society of Mechanical Engineers.

vided we can escape a major catastrophe, war or prolonged unemployment, the purely production problem is going to be less important in the future.

THE REAL PRODUCT OF INDUSTRY

Let me turn away, therefore, from wages, prices, and markets —the topics which so largely concern us at the moment; let me move into the distance, to those wider horizons to which managements must ever turn if they are to remain managers.

We whose relationship to the operating details of business is indirect are afforded an opportunity to sit beside the highway of business and watch the caravan of industry pass. We see it reach the end of the known road and pass on to management the unfolding picture of its progress. But perhaps our most important function is to predict its course over the broad and unmarked plains of the unknown future.

Now that this country seems to be on the threshold of economic plenty, I feel deeply that management's social responsibility needs to be turned increasingly toward the satisfaction of noneconomic aims—status, prestige, integrity, understanding, and self-development. We in management largely enjoy these noneconomic or social privileges. Employees, it is true, may use the considerable economic benefits they obtain from their work to satisfy their noneconomic needs. Yet higher wages on the job have no more brought industrial peace than higher allowances tie children more closely to their parents. Remember, that approximately one half of their waking time is spent on the job. Cramp people, bottle them up, deny them the fulfillment of their noneconomic aspirations, and you invite trouble. The growth of the union movement took place partly in response to the worker's desire to express himself, to be a real person. The success of some companies adept in developing good human relations has given them the "competitive edge" over their rivals.

But, there is an even more important reason for turning to the noneconomic, and here I should like to quote from a very remarkable forecast:

"The business system must accept its social responsibility and devote itself primarily to service, or the community will ultimately make the attempt to take it over in order to operate it in its own interest.

"The spectacle of the attempt to accomplish this result in eastern Europe is certainly not so attractive as to make us desire to try the same experiment here. Hence, we should act, and act quickly, on the former proposition." This warning was uttered by Henry Laurence Gantt in his last public message before his death in 1919.

What Gantt advocated was less autocracy on the part of employers, a movement toward co-operation and the widespread use of nonfinancial as well as financial incentives.

In many countries where management has failed to provide its employees with adequate nonfinancial incentives, the union movement has obtained recognition of its members' noneconomic aims at the political polls. If our employees are to continue to accept our economic way of life, we need to integrate our interests with theirs.

How, then, can we escape the tyranny of the belief that the only tie of a worker to his business is the wage he gets and the physical product he turns out? We must provide for all the people in industry what Elton Mayo has so aptly called "growth in capacity," that is, social as well as technical skills, set in the framework of social responsibility. These practices have been studied and tested by a small vanguard of management pioneers, forged in the heat of action in the shops, on the assembly lines, in the offices. May I offer them to the future as the keystone for the complex structure of industrial peace?

I believe that the most important single development in the business of the future will be a share for employees in many of the work satisfactions now enjoyed largely or exclusively by those rather high up in management.

Of course, management must continue to manage and to insist that business be controlled by those who can insure its survival and growth, and who should be just arbiters among the various claimants to its income. By "just arbiters," I do not mean to imply that managers have inherently any greater sense of justice than employees or stockholders. It is only that a natural process of selection insures that they do not remain managers long if they do not apportion that income fairly. If employees are slighted, the most capable leave for more lucrative fields; and, in consequence, the business loses out in competition. If a fair proportion of the increased income from technological improvements is not passed on to consumers in the form of lower prices, the result is very similar. If stockholders are not justly dealt with, the company may very soon find itself cramped for capital.

However, to return to the work satisfactions which management must now seek to provide, one of the basic requirements is security.

One aspect of this is mental—the feeling of being treated fairly on the job. In many instances, management's past attitude of autocracy has developed in the employee the feeling that only the union can protect him.

A second type of employee insecurity is social. This type stems from management's tendency to do all the talking and none of the listening, from its lack of knowledge of the feelings and opinions of the rank and file, from the failure of superiors to release the thinking of their subordinates, to encourage personal initiative. It is due in part also to the isolation of the employee from companionship, from craftsmanship, from the finished product. Where it exists, management has overlooked the dynamics of consultation, of generosity and patience, of group work and group incentive.

A third aspect of employee insecurity is physical. Repetitive production, standardization of methods of work, uniformity of pace, control of speed by the machine, work on small details have caused deep-seated psychological dissatisfaction. True scientific management takes account of these phenomena. In the daily practice of the factory, shall we not have to integrate individual motions into a pattern of work?

Security—mental, social, physical—can we retrieve it? I believe the answer is yes, if we can but kindle participation by employees in group activity; participation by management in its own development. Or, as Lawrence Appley put it, at a meeting of the American Management Association (AMA), if management is getting things done through other people then management is most importantly the development of people and not the direction of things.

Active group participation by employees in specific areas where they can make a real contribution is one of the mainsprings of industrial peace. It gives employees a more direct concern with the source of their livelihood. They become more responsible on the job if they participate in accident and waste reduction, better attendance and training, control of quality and maintenance, improvement of discipline and job attitude. Employees become more interested in their jobs if they are consulted and rewarded for their ideas on the job. Employees might be less opposed to new methods and other technical changes if these changes were explained, if the fact that they reduce strain and fatigue was made clear. Employees might show better understanding of their jobs if they knew more of management's aims and policies, the economics of the company and industry, if management knew more of what the worker really thinks. If we proceed gradually and in mutual good faith, we may yet develop a pattern for industrial peace.

Perhaps, meetings of groups of managers—such as we have in the ASME and the AMA are one important way of conquering the future in the present. These group gatherings show us the ingredients of successful foresight, constituted as they are on the basis of equality of participation, willingness to lay bare differences and to integrate them, drawing the best from the past and present, in order to shape the future. As Harold Butler, one of the most distinguished international labor observers, put it cogently:

"Indeed, one of the most striking features of American industrial life is the freedom with which big employers and the managers of big establishments compare notes, exchange experiences, and profit by each other's knowledge and mistakes. Their frankness in discussing their own methods and their willingness to accept criticism of them are certainly factors in their success."

If business can grasp some of the social responsibilities I have outlined, it has the potentialities to bring the good things of life into the lives of all. A great thinker said of us many years age:

"The solution of the world's problems must eventually be built up from all the little bits of experience wherever people are consciously trying to solve problems of relation. And this attempt is being made more consciously and deliberately in American business than anywhere else."

Perhaps it would be truer to say that "progressive" business is making a conscious and deliberate effort toward this end. If as we may expect, the rest of the procession eventually catches up with the vanguard, many of the most deep-seated aspirations of mankind may achieve fulfillment.

GANTT *and* DODD

An Appraisal and an Appreciation

By JOHN M. HANCOCK

CHAIRMAN OF THE BOARD, AMERICAN MANAGEMENT ASSOCIATION, NEW YORK, N. Y.

WE are here today to brighten the memory of Henry Laurence Gantt, to think briefly of the ideas and ideals he possessed, to weigh them in the light of another day in a rapidly changing world, to ponder over how this engineer sensed the coming of the great sweep of the rising power of the common man, and how he kept his ideas in tune with it.

No man here needs to be told anything about the jobs he performed or how he laid out the essential facts in his control plans and provided in obvious shape the foundation for judgments and the basis for action. Everyone knows that he sought to create better management by providing better tools and better methods, not to the end that the work of management would be easier, but so that management could utilize its full capacity and better serve its purposes for the greater good of the country. He applied to business the philosophy of service that Woodrow Wilson expressed in this way:

> You are not here merely to prepare to make a living. You are here to enable the world to live more amply, with a greater vision, with a finer spirit of hope and achievement. You are here to enrich the world, and you impoverish yourselves if you forget your errand.

He saw that profits were the inevitable and wholly proper result of giving the world what it wanted in the way of goods or services. That was the sound way because it was not only the best way but was in fact, for a free people, the only way to be sure of the desired results over a long period. He saw that business and industry must render essential service if they are to survive. He knew that the community needs service first, regardless of who gets the profit, because its life depends upon the service it gets.

The great struggle Gantt had with the older ideas still current in his day centered around Gantt's ideas regarding a "humanistic attitude toward workers" and his urging a "policy of leading" to replace the "policy of driving" workmen. That was the basis of his break with his business associate, Frederick W. Taylor. Gantt was more interested in practical improvement than in engineering perfection and precise measurements, and he relied on voluntary improvement of operating conditions by management and workers jointly through the educating disclosures of his charts, the forerunner of employee-relations programs of today. Both men sought efficient and economical production; they differed as to method but not as to objectives. Then, as now, production was the answer to most current problems. Note how Gantt once stated it:

> The doctrine of service . . . . is not only good economics and eminently practical, but because of the increased production of goods obtained by it, promises to lead us safely through the maze of confusion into which we seem to be headed and to give us that industrial democracy which alone can afford a basis for industrial peace.

That was a good approach to one problem in the field of human relations and, incidentally, the idea of service would be a good program for the nations of the whole world to follow in their international relations. That seems as obvious as the other basic idea about the importance of production.

Today we see production as the first and probably the only answer to our pressing domestic problem of inflation. We see the whole world suffering from the same trouble for which Gantt saw the answer some decades ago. He was thinking of the America he knew, an America in which we didn't dream of a regimented economy or a socialized state. He knew then what this war has proved to us—that no plan of coercion will result in as much production as a system under which free men work together for a common end. He knew that good working conditions for free men, with help given to show them how to do their jobs in the easiest possible way, and with a fair reward based on production efficiency, are the means by which a higher standard of living is attained not only for the producers but the consumers as well. He wanted ways to be found by which men could produce more with less effort,

---

Remarks made at the presentation of the 1947 Gantt Medal to Alvin E. Dodd, at the Annual Meeting, Dec. 1–5, 1947, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

and he proposed to give them their fair share of the resulting gains. He believed in mass production and its attendant benefits to the entire population.

He was essentially a leader, possessed of creative power, high purpose, courage, independence, and tireless energy. That's my picture of the man who was such an influence on professional and business thinking in my younger days. That's the man whose memory we are brightening today by this ceremony of recognizing another man who carries forward the Gantt spirit, by presenting him with the Henry Laurence Gantt Gold Medal.

This Medal is to memorialize the distinguished achievements and great service to the community rendered by Henry Laurence Gantt, management engineer, industrial leader, and humanitarian, and is to be awarded for "distinguished achievement in industrial management as a service to the community." The Board of Award consists of four persons appointed by The American Society of Mechanical Engineers and four appointed by the American Management Association, subject to approval by the governing bodies of these two organizations. Speaking on this occasion primarily on behalf of the American Management Association, and only incidentally on my own behalf, we are immensely proud that the choice this year rested upon our president, Alvin E. Dodd.

Who is this Alvin E. Dodd whom we are here gathered to honor? Why have men, sensitive to events and to the human beings who fashion them, sought out this particular individual for this award? Why, in a world in which the engineers and managers perhaps even more than the statesmen chart the destiny of mankind, do we choose this one man for this distinction?

As president of the American Management Association, he is of course himself a manager. But direction of the activities of a small corps of men and women, however brilliantly effected, is of itself surely no outstanding achievement. And if we reckon with the fact that in some ten years he built the American Management Association up from the depression years to the prosperous substantial institution it is today, why that is only what a host of other managers have done in other provinces. I will try to answer your question. There was the institution itself, the American Management Association. Its ideals when Alvin E. Dodd came upon it were no less than they are today. Then, as now, it sought to enhance the management art. Its goal was good and true, its accomplishments were not widely known, its influence was not broadly felt. It was not a truly effective sort of institution when, so little more than ten years ago, Alvin E. Dodd assumed control of its destiny. Today, disdaining propaganda and special pleading and transient conviction, clinging resolutely to its dispassionate function of doing the managerial job better, it stands as the most vital force in the shaping of management thought and standard.

It is this simple fact, that the American Management Association performs its function pre-eminently well, that provides the true and enduring monument to the genius of Alvin E. Dodd.

We here pay tribute to a man whose immense influence pervades our whole managerial structure. For there is probably no major executive in American industry whose accomplishments do not in some measure bear testimony to the profound impact of Alvin E. Dodd's fundamental handiwork.

But we can comprehend the magnitude of the man's influence only when we arrive at the simple realization that it has been almost wholly anonymous. Only a tiny handful of top managers will avow consciously that Alvin E. Dodd fathered their deeds. But a vast host performs daily the miracles of industrial progress with no awareness of that man's accomplishments to which they so greatly owe their managerial proficiency.

It is the goal of education to equip the individual for optimum usefulness to himself and society. To that objective Alvin E. Dodd has contributed richly, yet I would not call him a great educator. It is the goal of management to effect an optimum distribution of goods and services to mankind. To that objective, Alvin E. Dodd has given greatly, yet I would not call him a foremost manager. His has been that uncommon ability to integrate the educational mission and the managerial. That, too, in effect if not in detail, distinguished the achievements of that rare company of management giants among whom we rightly number Henry Laurence Gantt.

Why do we honor Alvin E. Dodd? Why do we place on him this supreme symbol of management achievement, the Henry Laurence Gantt Memorial Medal? It is because, out of the chaotic and unorganized deeds of many managers, he has fashioned a unified orderly structure of thought and technique that have paced the progress of the art of management itself. American business executives are known for their search for understanding—understanding of problems and their solutions. Here was the field for work, the opportunity, and the challenge, too. Here was the chance to give managers what they wanted and to improve them by the giving—the service idea of Gantt.

It is easy to state the simple fact. It is difficult to take the intricate measure of a man so gifted in the ability to integrate into a meaningful pattern the random concepts and accomplishments of many specialists in diverse tasks and industries, to draw out from each with undeviating sureness everything that is sound and enduring, and then to transmit it in form usable by the many and used by the legion of managers whose work in the aggregate fashions our scheme of life.

That is Alvin E. Dodd's contribution to management, and a great contribution it is. We do public honor to the few; but the science of management owes its advance to the deeds of many thousands of obscure managers, each contributing his little measure of thought and technique. The individual accomplishment stands forlorn. It achieves effectiveness and power only when it is united with countless other little achievements into what Galsworthy, in another context, once called a "pyramid of meaning." It is that role of integrating, of clothing with meaning, that Alvin E. Dodd has performed with such distinction in the management sphere. It is his performance of that role that makes us know that, in honoring Alvin E. Dodd, we add luster and honor to the tradition and memory of Henry Laurence Gantt.

TECHNOLOGICAL STAGNATION in Great Britain is both a warning and a lesson to the United States, William J. Kelly, Chicago industrialist and president of the Machinery and Allied Products Institute, declared in a report on technological efficiency in England recently completed by the Institute.

The average industrial worker in England produces only about one third as much as the average American, and because of antiquated equipment and methods, labor requirements per unit of output in some cotton textile processes are eight times as great in England as in the United States, Mr. Kelly said.

In a comparison of 25 industries it was found that output per worker is greater in all cases in the United States than in England, and in many instances it is three or four times as great, he said. On the basis of output per man-hour the contrast is even sharper, because the English work week is longer.

"We are by no means immune to the degenerative processes that have sapped the vitality of industry overseas," Mr. Kelly said.

UNDERGROUND GASIFICATION[1]

An Account of Experiments on Coal Conducted at Gorgas, Alabama

By MILTON H. FIES[2] and W. C. SCHROEDER[3]

UNDERGROUND gasification, as a means for releasing and utilizing energy from coal, has been considered and discussed in the engineering and mining world almost as long as coal has been burned. Advantages of the scheme over conventional and often difficult mining methods are frequently obvious and may include elimination of much human underground work, lower cost both in dollars and effort in utilizing the energy from coal, and elimination of handling millions of tons of coal and ashes. It also may be pointed out that there may be disadvantages and difficulties, such as much of the coal may be wasted through incomplete combustion, underground control may be difficult or impossible, the gas secured could be too lean to be useful, and too much work may be involved in preparation for combustion—to name only a few.

It would be foolhardy not to recognize the serious nature of the disadvantages, yet there is no certainty that even one of them will appear or that it cannot be surmounted. At the same time, some of the advantages apparently are definite. Under such circumstances, it is amazing that only one country of the world has thought underground gasification worth serious trials and, even in this case, only in relatively recent years.

The lack of investigation may trace to the difficulty of translating the work in terms of an experiment that can be carried out under control and observation in the laboratory, or, even if it is carried out in the coal bed, the difficulties of observation may prevent real progress, or perhaps the lack of investigation simply stems from unwillingness to expend the considerable amounts of time and money necessary for this type of work.

The Alabama Power Company was impelled by the recognition of the growing necessity for a low-cost, easily transportable, convenient, prime source of energy, and a long-cherished purpose to further the advancement of the South, to undertake the experiment. The fruits of successful underground-gasification methods could now be so great that the Bureau of Mines believes that experimentation should no longer be delayed; on the basis of this belief, one test has already been completed at Gorgas, Alabama.

At this location the Alabama Power Company operates a central station which is surrounded by mines now producing about 2000 tons of coal a day. Since the plant is on the Warrior River, the site offers the unusual juxtaposition of coal, water, and power plant. The product from the underground gasification can be delivered to the powerhouse for combustion under the boilers. If necessary, this probably could be done without cooling the gas completely, and some of the sensible heat as well as the heat of combustion could be utilized under the boilers. If the underground-gasification method gasifies the coal quite completely, a high recovery of energy could be achieved.

Turning from this specific case to the more general application of underground gasification in electric power generation, it sometimes may be impossible to use the gases in a boiler-steam-turbine cycle. The gases probably will be lean, and transportation over long distances would be uneconomic, while lack of water may make it impossible to locate a steam power plant near the coal. Here the gas turbine offers a means of generating power which appears suited to the circumstances.

HISTORICAL

The first reference to underground gasification of coal of which we have positive knowledge is that in 1868.[4] Sir William Siemens suggested the gasification of slack and waste coal in the mine. The first mention that coal might be gasified in situ is attributed by the Russians to Prof. D. I. Mendeleev, in 1888.[5] The initial practical approach to this method, however, was in 1909,[5] when a British patent was granted to an American, A. G. Betts. Betts's method of gasifying coal in the seam consisted of starting a fire at the foot of one or more shafts or boreholes, forcing air and steam through a pipe, and drawing off the resultant gases through the same or other shafts or boreholes.

In March, 1912, Sir William Ramsay,[5] at a luncheon in London on the occasion of an "International Smoke Abatement Exhibition" suggested that "just as deposits of salt were worked, not by mining salt, but by pumping in water which was recovered as brine, so it would be ideal, instead of mining coal, to have retorts in the bowels of the earth for the production of gas." Sir William referred to boring holes to the coal, the possibilities of producing a gas made up of hydrogen and carbon monoxide, and the use of gas engines located at the mine mouth for the production of electricity. He suggested further, since a coal strike was on in Great Britain at the time, that the miners had best watch their step.

Sir William Ramsay, according to an associate, Sir Maurice Bell, had planned to undertake an experiment at Hett Gill, near Tursdale[5] Colliery in Durham, but World War I came, and Ramsay died shortly thereafter.

About this same time, Lenin was in political exile in Cracow. He wrote a futuristic article on underground gasification for

---

[1] Published by permission of the Director, Bureau of Mines, U. S. Department of the Interior, Washington, D. C. Data on the test at Gorgas were taken from the report by James J. Dowd, James L. Elder, and J. P. Capp on "Experiment in Underground Gasification of Coal, Gorgas, Alabama," to be published as a Bureau of Mines Report of Investigations 4164.

[2] Consulting Engineer and Manager of Coal Operations, Alabama Power Company, Birmingham, Ala.

[3] Chief, Office of Synthetic Liquid Fuels, Bureau of Mines, Washington, D. C. Mem. ASME.

Contributed by the Fuels Division and presented at a Joint Fuels Conference of the American Institute of Mining and Metallurgical Engineers and The American Society of Mechanical Engineers, Cincinnati, Ohio, Oct. 20–22, 1947.

[4] "Underground Gasification of Coal—Further Research Advocated," *South African Mining & Engineering Journal*, vol. 57, January 18, 1947, pp. 555 and 557.

[5] "The Underground Gasification of Coal, Survey of the Literature," by L. J. Jolley and N. Booth, *Fuel in Science and Practice*, vol. 24, 1945, pp. 31–37.

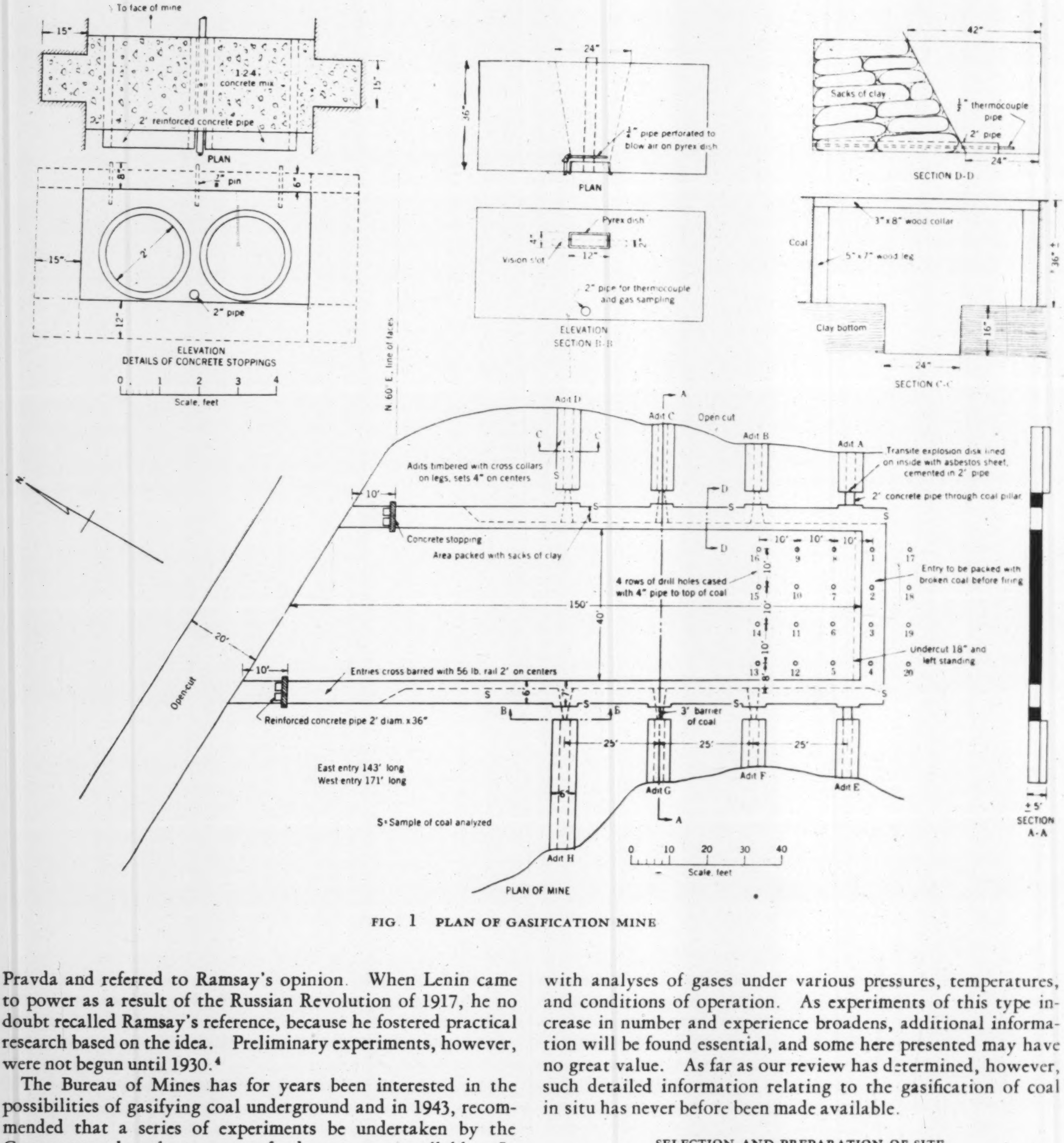

To face of mine
15"
1:2:4 concrete mix
2' reinforced concrete pipe
15"
PLAN
8"
7/8" pin
6"
2'
15"
12"
2" pipe
ELEVATION
DETAILS OF CONCRETE STOPPINGS
0 1 2 3 4
Scale, feet
24"
36"
1/4" pipe perforated to blow air on pyrex dish
PLAN
Pyrex dish
Vision slot
12"
2" pipe for thermocouple and gas sampling
ELEVATION
SECTION B-B
42"
Sacks of clay
1/2" thermocouple pipe
2' pipe
24"
SECTION D-D
3"x8" wood collar
Coal
5"x7" wood leg
36"
Clay bottom
16"
24"
SECTION C-C
N 60° E, line of faces
Adit D
Adit C
Open cut
Adit B
Adit A
A
C
C
Adits timbered with cross collars on legs, sets 4' on centers
Transite explosion disk lined on inside with asbestos sheet, cemented in 2' pipe
2' concrete pipe through coal pillar
10'
Concrete stopping
Area packed with sacks of clay
D
D
S
10' 10' 10'
16 9 8 1 17
4 rows of drill holes cased with 4" pipe to top of coal
15 10 7 2 18
Entry to be packed with broken coal before firing
150'
40'
14 11 6 3 19
13 12 5 4 20
Undercut 18" and left standing
N
20'
Opencut
10'
Entries cross barred with 56 lb. rail 2' on centers
Reinforced concrete pipe 2' diam. x 36"
B
B
6'
3' barrier of coal
25' 25' 25'
East entry 143' long
West entry 171' long
Adit G
Adit F
Adit E
A
S = Sample of coal analyzed
Adit H
0 10 20 30 40
Scale, feet
PLAN OF MINE
±5'
SECTION A-A

FIG. 1 PLAN OF GASIFICATION MINE

Pravda and referred to Ramsay's opinion. When Lenin came to power as a result of the Russian Revolution of 1917, he no doubt recalled Ramsay's reference, because he fostered practical research based on the idea. Preliminary experiments, however, were not begun until 1930.[4]

The Bureau of Mines has for years been interested in the possibilities of gasifying coal underground and in 1943, recommended that a series of experiments be undertaken by the Government, but the necessary funds were not available. In view of this interest, a representative of the Alabama Power Company discussed the matter of an experiment with the Director and the Chief of the Fuels and Explosives Branch, of the Bureau of Mines, in the fall of 1946. After necessary discussions and inspection of several possible sites by the members of the staff of the Bureau at Gorgas, Alabama, where the Alabama Power Company owns an extensive coal acreage, the preparatory work was begun in October, 1946, and the first experiment in the United States set under way at 2:00 p.m., Jan. 21, 1947.

The data presented herein are the first of a technical nature in this country, recounting as they do the details of the plans and operation of an experiment in underground gasification, with analyses of gases under various pressures, temperatures, and conditions of operation. As experiments of this type increase in number and experience broadens, additional information will be found essential, and some here presented may have no great value. As far as our review has determined, however, such detailed information relating to the gasification of coal in situ has never before been made available.

SELECTION AND PREPARATION OF SITE

The site for the underground gasification work had to meet two major requirements, namely, that the coal was or could be isolated to prevent spreading of the fire, and that the underground area could be examined at the end of the test to determine the effect of the fire. The area finally selected near Gorgas was a narrow hilltop about 450 ft long in a north-south direction and 350 ft wide. About 30 to 45 ft below the surface of the hill was the Pratt bed, in which the gasification was conducted. The Pratt bed outcrops on the east, south, and west side, and the isolation of the bed was completed by a cut with a minimum width of about 20 ft from the top of the hill through the coal bed.

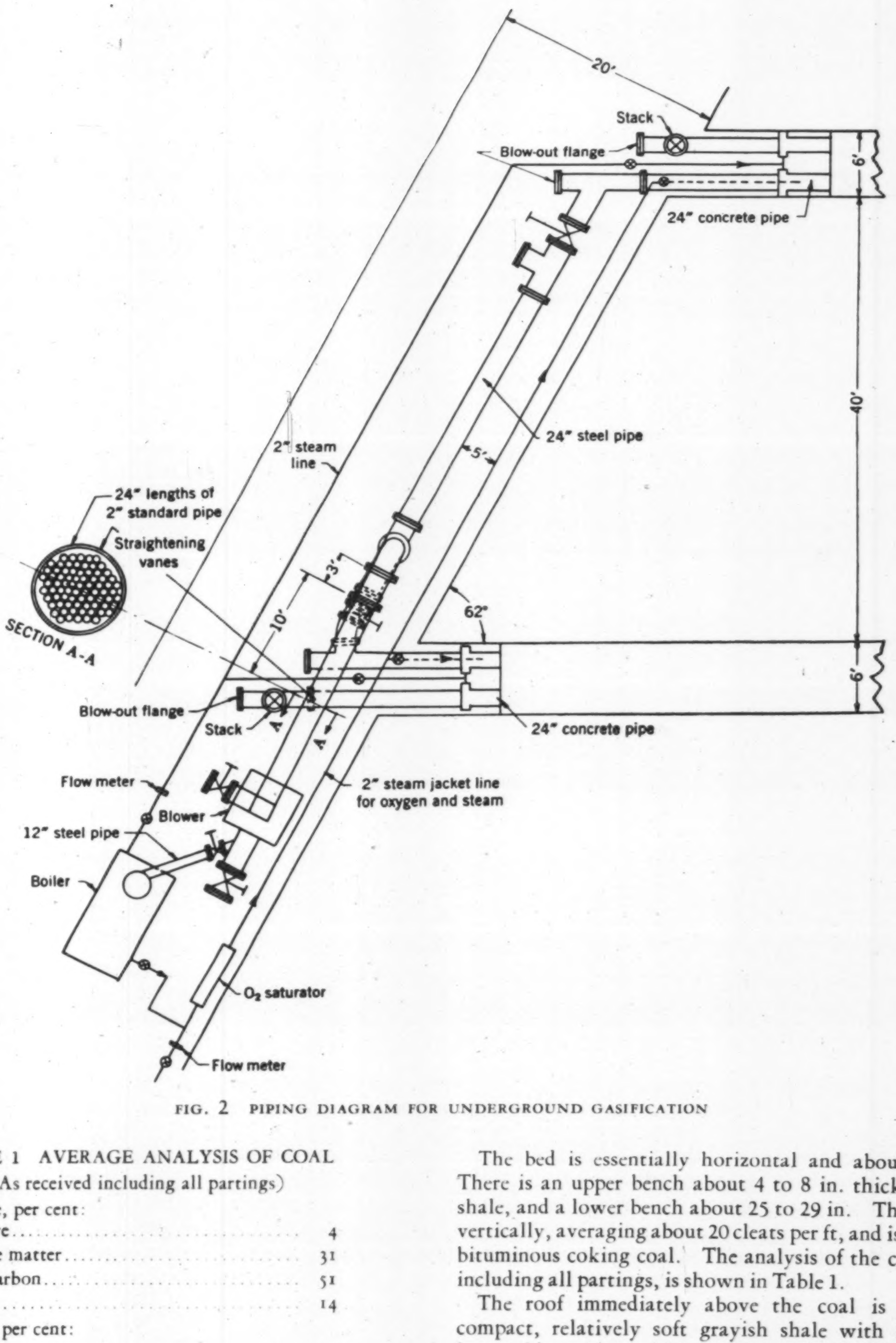

20'
Stack
Blow-out flange
6'
24" concrete pipe
40'
24" steel pipe
5'
2" steam line
24" lengths of 2" standard pipe
Straightening vanes
SECTION A-A
3'
10'
62°
6'
Blow-out flange
Stack
A
A
24" concrete pipe
Flow meter
Blower
2" steam jacket line for oxygen and steam
12" steel pipe
Boiler
O₂ saturator
Flow meter

FIG. 2 PIPING DIAGRAM FOR UNDERGROUND GASIFICATION

TABLE 1 AVERAGE ANALYSIS OF COAL
(As received including all partings)

Proximate, per cent:	
Moisture	4
Volatile matter	31
Fixed carbon	51
Ash	14
Ultimate, per cent:	
Sulphur	1.3
Hydrogen	5
Carbon	69
Nitrogen	1.5
Oxygen	9.2
Ash	14
Heating value, Btu	12400
Fusibility of ash, deg F:	
Initial deformation	2700
Softening	2780
Fluid	2900

The bed is essentially horizontal and about 35 in. thick. There is an upper bench about 4 to 8 in. thick, 2 in. of bony shale, and a lower bench about 25 to 29 in. The coal is cleated vertically, averaging about 20 cleats per ft, and is a high-volatile bituminous coking coal. The analysis of the coal as received, including all partings, is shown in Table 1.

The roof immediately above the coal is dense-textured, compact, relatively soft grayish shale with light and dark layers, $^3/_{16}$ to $^1/_4$ in. thick parallel to the bedding and giving it a laminated appearance. The analysis of the moisture-free roof material was fixed carbon 6 per cent, volatile matter 10 per cent, and ash 84 per cent. Above this was shale and weathered sandstone with numerous vertical slips which were not continuous.

The mine ways were developed for underground gasification as shown in Fig. 1. The roof of the mine was supported by steel rails on 2-ft centers. All entries were 6 ft wide and 3 ft high (approximate thickness of coal). An undercut 18 in. deep and about 8 in. high was made at the end of the center

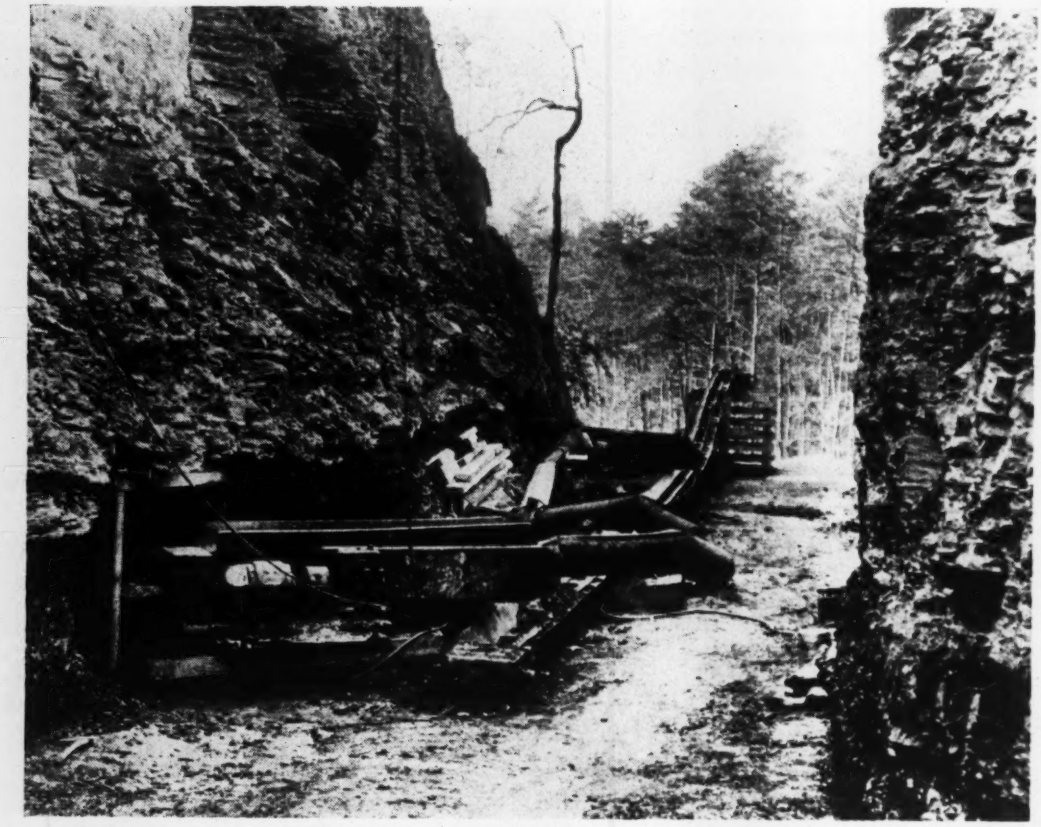


FIG. 3 NORTH OPEN CUT, SHOWING DRAG-CHAIN CONVEYERS

coal pillar to help insure circulation of air when the fire was started even though the roof of the crosscut should fall quickly at the beginning of the experiment. The remainder of the crosscut was filled with loose coal, and some wood and oil were put under drill hole no. "1" to aid in starting the fire. The outby walls of the east and west entries were lined with clay bags to confine the combustion in so far as possible to the center pillar of coal.

The sides of the hill were cut away with a bulldozer to give the outcrop line shown in Fig. 1. Eight observation adits were cut as indicated and six were equipped with a pyrex-glass port sealed in the pillar between the adit and the entryway. The other two had concrete pipes and explosion disks, as well as observation ports, sealed in place. In the combustion zone these observation ports were protected by clay bags as well as possible. Each port was equipped with a thermocouple and gas-sampling pipe.

A series of holes were drilled from the surface into the coal or the crosscut, as shown in Fig. 1. These were used for gas samples and thermocouples.

Near the open cut, two concrete pipes of 2 ft diam were sealed about 10 ft from the mouth. These were connected to the blowers and stacks as shown in Fig. 2, to permit reversing the flow of air and combustion gas through the mine. To prevent overheating of the stacks, a water spray was provided in the entrance pipes. The blower, boiler, piping, and other equipment shown in this figure were located near the bottom of the 20-ft open cut. The boiler was used to furnish steam for the tests. Also, by drawing air through the fire bed, it could be used to supply relatively inert gas when this was needed. Blowout flanges were inserted at certain places in the piping to relieve the pressure in case of an explosion.

The blower was a positive-pressure type, driven by a 75-hp motor which would deliver 7350 cfm at 2 psi when operated at 175 rpm.

Figs. 3, 4, and 5 show some views of the site during its preparation and operation.

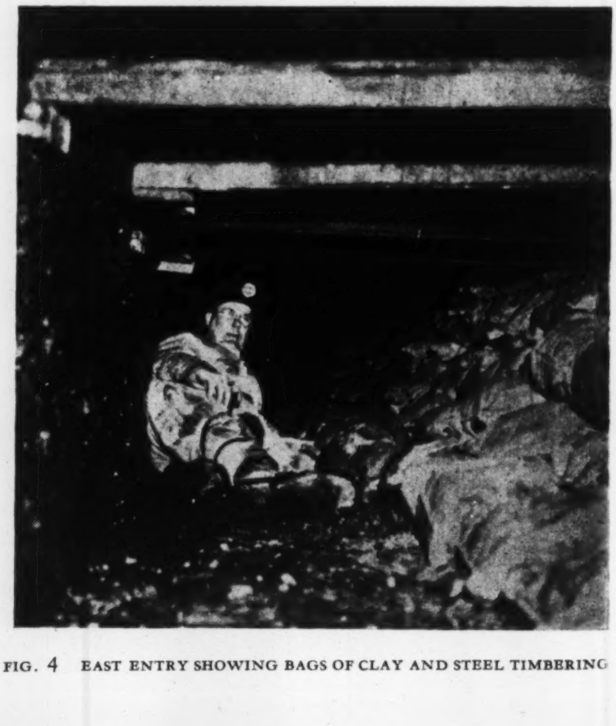


FIG. 4 EAST ENTRY SHOWING BAGS OF CLAY AND STEEL TIMBERING

OPERATION

With 2400 cfm of air going into the east entry, two or three small magnesium incendiary bombs were dropped down sampling pipe No. 1, which was then capped. Ignition was rapid and within a few minutes heavy smoke was coming out of the stack as shown in Fig. 6. Within a few hours the thermocouples in the ignited area reached 1000 F.

Almost simultaneously, trouble started with leaks at observation portal E, for hot gases and flames had been sweeping the pyrex-glass window and the transite disk sealed into the 24-in. pipe to a much greater extent than had been anticipated. The clay bags, which had been packed as close to the ports as possible, did not offer much protection against the flames. After a few hours of operation the portal was leaking so badly that it was necessary to close it off completely; this was done by putting in a few bags of rock dust and then pushing earth into the remainder of the portal.

During the first week or 10 days of operation, all observation ports leaked and had to be closed off. These difficulties, coupled with others encountered in maintaining the relatively old blower, made it impossible to achieve continuous or steady-state operation during this important period.

During the entire period of underground gasification, an attempt was made to center the combustion in or near the crosscut by reversing the air flow from time to time. This was done every few hours during the first few days and roughly once a day after a relatively steady state had been achieved. This procedure was not altogether successful since both entries tended to burn toward the source of oxygen or air; and, as the experiment went on, leaks developed where the pipes from the blower passed through the stoppings and around the edges of the stoppings. These were sealed as well as possible by guniting.

Overheating of the metal duct to the stack and of the stack itself was prevented by water spray at the mouth of the duct.

At the start of operations under a blower pressure of 8 in. of water, the air flow was 2400 cfm. Within a few days, under the same pressure, the air flow had fallen to 1200 cfm. Finally, it was necessary to raise the pressure to 40 in. of water to maintain this reduced flow. It would have been desirable to have a much higher air flow, but this was not possible because the maximum blower pressure was about 48 in. of water, and during the latter part of the test so much trouble was encountered with leakage through the coal seam to the outcrop, through the cover, and around the stoppings that even this pressure could not be maintained. It is believed that more air through the system could have given higher temperatures and richer gas.

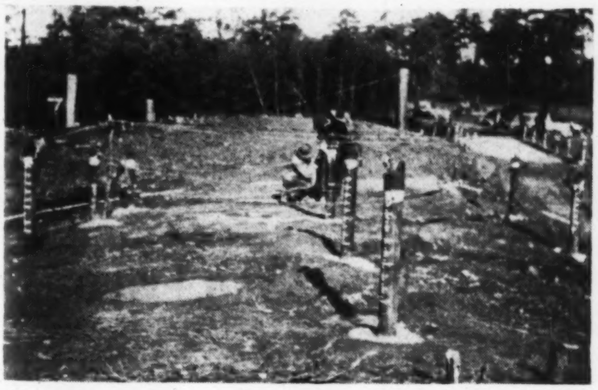


FIG. 5 SURFACE SHOWING DRILL-HOLE CASINGS WITH GRADUATED ELEVATION SCALES

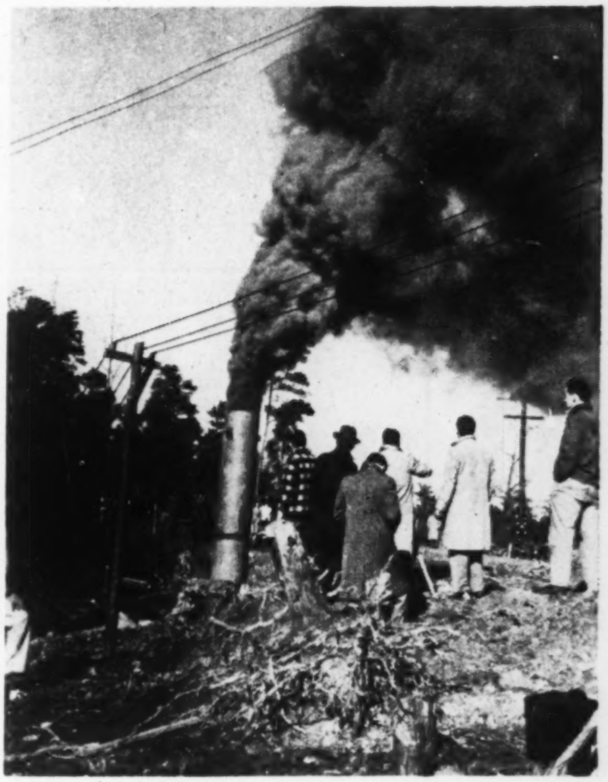


FIG. 6 WEST STACK AFTER COMBUSTION STARTED

The maximum temperatures measured were about 2200 F. In certain areas the temperatures undoubtedly went considerably higher, for rock of a higher fusion temperature was melted, but they could not be measured with the chromel-alumel thermocouples.

During periods in which blasting was done with air alone, the heat content of the gas at the stack varied from a minimum of 20 to a maximum of 76 Btu per cu ft, with an average of about 45. Under these conditions, a little over 100 cu ft of gas was made per lb of coal burned, and the ratio of heating value recovered in the gas to heating value of the coal (as received) was about 0.4. The approximate average percentage composition of the stack gas is given in Table 2.

The authors believe that these results represent essentially the least satisfactory which should be expected from under-

TABLE 2 AVERAGE PERCENTAGE COMPOSITION OF STACK GAS

	Per cent
CO_2	15.2
O_2	1.0
Illuminants	0.2
H_2	5.2
CO	2.9
CH_4	1.5
N_2	74

TABLE 3 AVERAGE PERCENTAGE COMPOSITION OF DRILL-HOLE GAS

	Per cent
CO_2	11.7
O_2	0.4
Illuminants	0.2
H_2	7.0
CO	9.1
CH_4	1.4
N_2	70.2

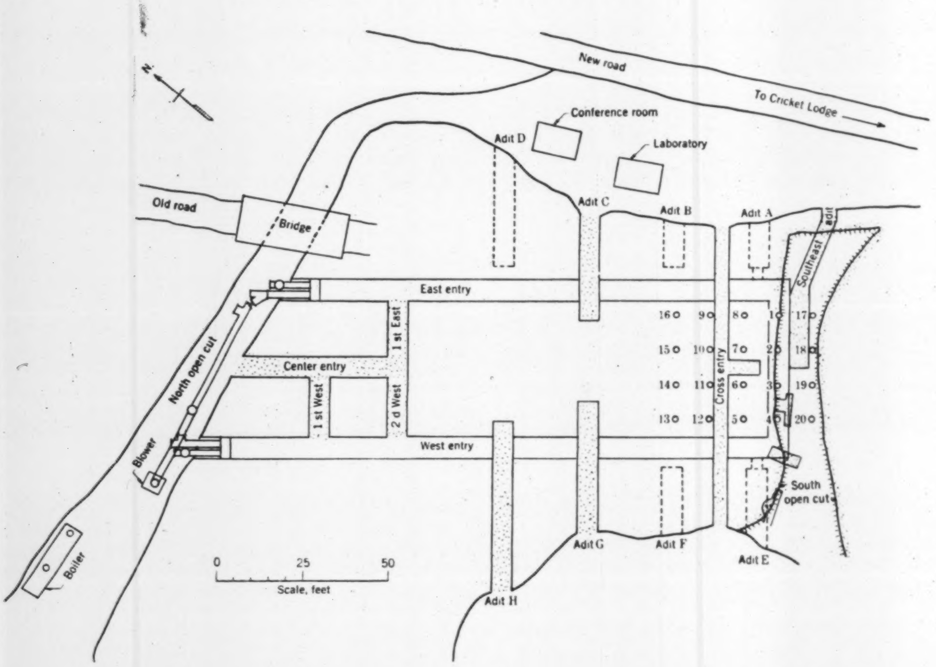

N.
New road
To Cricket Lodge
Conference room
Laboratory
Adit D
Adit C
Adit B
Adit A
Southeast adit
Old road
Bridge
East entry
1st East
Center entry
1st West
2d West
West entry
Cross entry
16o 9o 8o 1o 17o
15o 10o 7o 2o 18o
14o 11o 6o 3o 19o
13o 12o 5o 4o 20o
North open cut
Blower
Boiler
South open cut
Adit G
Adit F
Adit E
Adit H
0 25 50
Scale, feet

FIG. 7 EXPLORATION MAP OF UNDERGROUND GASIFICATION RESIDUE

ground gasification. Higher temperatures in the mine would strongly favor the production of a richer gas; and these might be achieved by eliminating leaks from the coal seam, greater air velocities, or preheating of the incoming air.

Indicative of what might be expected was the heating value of the gas taken from various drill holes over the crosscut which was analyzed and from time to time burned under the small field boiler furnishing steam for the experiment. A total of 450,000 cu ft of gas, with an average heating value of 70 Btu, was burned over a 6-day period. Its average composition is given in Table 3.

It will be noted that this gas is considerably lower in CO_2 and higher in CO and H_2 than the stack gas. In addition, the heating value often reached 90 Btu, and the maximum determined value was 108 Btu.

It should be recognized that although these references to the gas produced during the course of the experiment are significant, gas quality was not considered fundamental. It was realized at the outset that the physical conditions pertaining to the experiment in the nature and shallowness of the cover, the likelihood of burnouts the limited capacities of the blower, etc., would necessarily affect the heating value of the resultant gas. What was sought primarily was definite information as to the combustion of coal in its solid strata in the earth, control of combustion, the action of the roof, and the effect of high temperatures on the overlying strata.

A detailed study was made to determine the change in gas composition as it traveled through the underground circuit. Substantially all oxygen was consumed in the first third of the passage, and the CO concentration averaged about 13 per cent at this point. During some periods it went as high as 22 per cent. Since the stack analysis shows lower heating values and lower CO content, it is apparent that some detrimental reaction occurred during the time the gas traversed the remaining two thirds of the passage.

One possibility immediately apparent is that some oxygen passed the hottest combustion zone (was not found in the analysis), and then rejoined the gas stream to react with CO. Of course other reactions might also account for these losses, but the point of immediate importance is that a gas of near or over 100 Btu can be secured by underground gasification, using air alone. Further experimentation is needed to determine exactly what these conditions are and the steps necessary to maintain them.

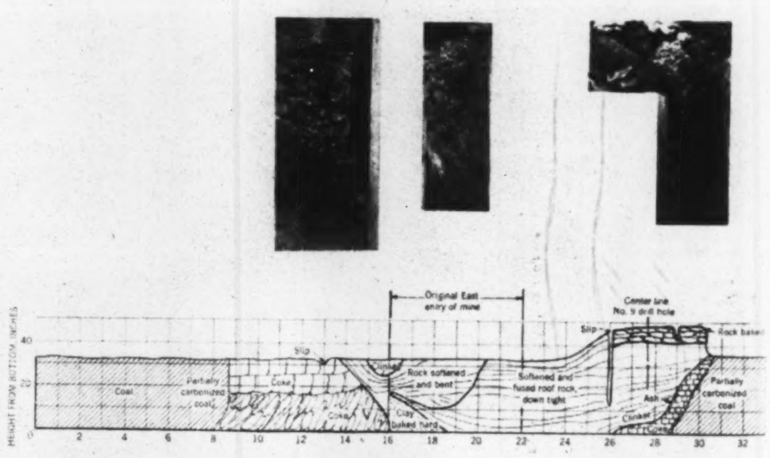
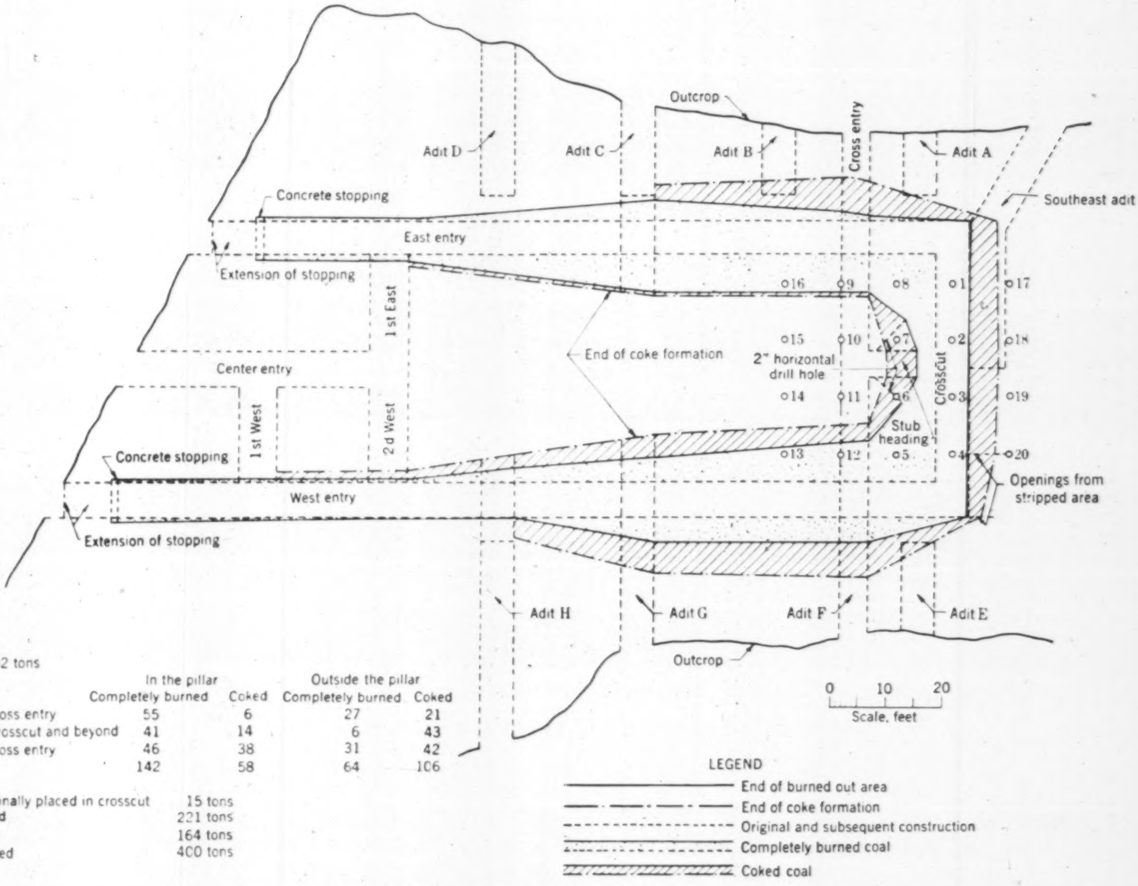

HEIGHT FROM BOTTOM, INCHES
0
20
40
Original East entry of mine
Center line No. 9 drill hole
Slip
Rock baked
Coal
Partially carbonized coal
Coke
Slip
Clinker
Rock softened and bent
Coke
Clay baked hard
Softened and fused roof rock, down tight
Ash
Clinker
Coke
Partially carbonized coal
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32

FIG. 9 SKETCH OF SOUTH

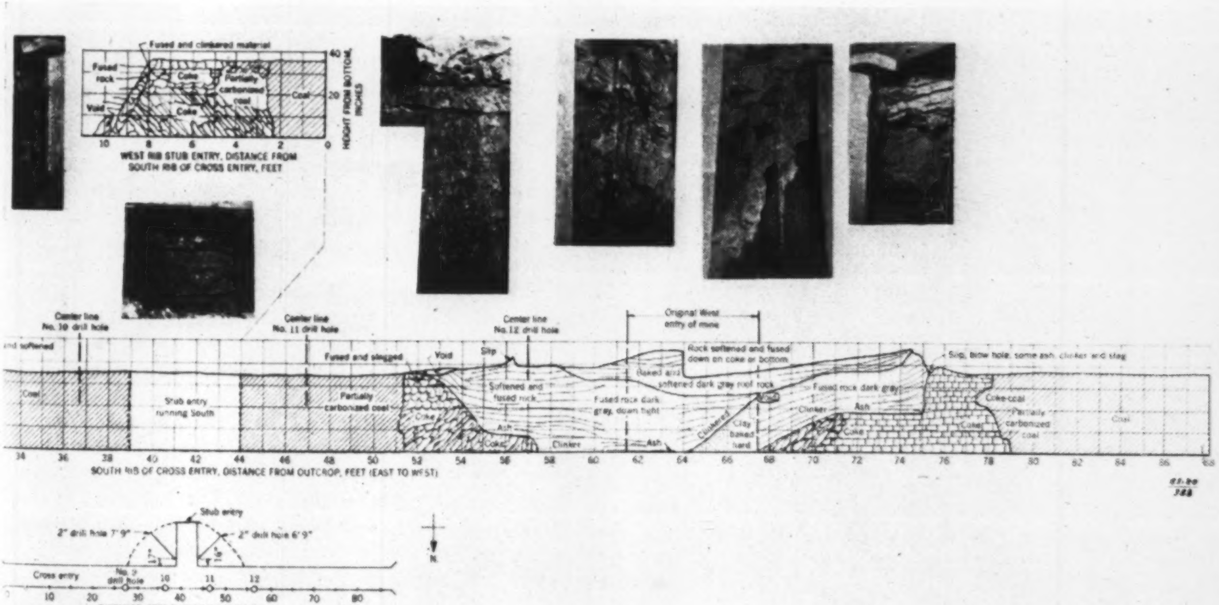

Outcrop
Cross entry
Adit D
Adit C
Adit B
Adit A
Southeast adit
Concrete stopping
East entry
Extension of stopping
1st East
o16 o9 o8 o1 o17
o15 o10 o7 o2 o18
o14 o11 o6 o3 o19
o13 o12 o5 o4 o20
End of coke formation
2" horizontal drill hole
Crosscut
Stub heading
Center entry
1st West
2d West
Concrete stopping
West entry
Openings from stripped area
Extension of stopping
Adit H
Adit G
Adit F
Adit E
Outcrop
0 10 20
Scale, feet
LEGEND
End of burned out area
End of coke formation
Original and subsequent construction
Completely burned coal
Coked coal

Coal in pillar 732 tons

Coal used, tons	In the pillar		Outside the pillar	
	Completely burned	Coked	Completely burned	Coked
East portal to cross entry	55	6	27	21
Cross entry to crosscut and beyond	41	14	6	43
West portal to cross entry	46	38	31	42
Total	142	58	64	106

Broken coal originally placed in crosscut	15 tons
Total coal burned	221 tons
Total coal coked	164 tons
Total coal affected	400 tons

FIG. 8 COAL UTILIZATION


Fused and clinkered material
Fused rock
Void
Coke
Partially carbonized coal
Coke
Coal
40
20
HEIGHT FROM BOTTOM, INCHES
10 8 6 4 2 0
WEST RIB STUB ENTRY, DISTANCE FROM SOUTH RIB OF CROSS ENTRY, FEET
Center line No. 10 drill hole
Center line No. 11 drill hole
Center line No. 12 drill hole
Original West entry of mine
and softened
Coal
Stub entry running South
Partially carbonized coal
Fused and slagged
Void
Slip
Softened and fused rock
Coke
Ash
Coke
Clinker
Fused rock dark gray, down tight
Rock softened and fused down on coke or bottom
Baked and softened dark gray roof rock
Ash
Clinkered
Clay baked hard
Fused rock dark gray
Clinker
Ash
Coke
Coke
Slip, blow hole, some ash, clinker and slag
Coke-coal
Partially carbonized coal
Coal
34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88
SOUTH RIB OF CROSS ENTRY, DISTANCE FROM OUTCROP, FEET (EAST TO WEST)
Stub entry
2" drill hole 7' 9"
2" drill hole 6' 9"
Cross entry
No. 9 drill hole
10
11
12
N
0 10 20 30 40 50 60 70 80
DISTANCE, FEET FROM EAST OUTCROP
61-80
388

RIB OF CROSS ENTRY

RESULTS OF FOUR-DAY TEST

During a 4-day period, the effect of oxygen in the gasification was studied, using oxygen-enriched air (34 per cent oxygen), oxygen-air-steam (oxygen 32, nitrogen 43, and steam 25), and oxygen-steam (oxygen 65 and steam 35). Oxygen was supplied from a tank car of liquefied gas on a near-by siding.[6] A special truck with equipment for vaporizing the oxygen was located near this car, and the oxygen was carried by pipe line to the gasification operations. The maximum rate at which oxygen could be supplied, due to the limited capacity of the truck for evaporation, was about 200 fpm. Consequently, the results do not by any means indicate the full improvement that might be achieved by using much larger volumes of oxygen.

Table 4 shows that the average heating value ranged from 50 to 134 Btu, per cu ft for the various test conditions. Concentrations of carbon dioxide in all tests were very high indicating failure to establish high-temperature and optimum conditions for carbon monoxide and hydrogen production. A much larger flow of oxygen could have helped materially in this respect.

TABLE 4 AVERAGE HEATING VALUE AND GAS ANALYSIS WHEN OXYGEN WAS USED

Run	Btu per cu ft	Per cent by volume CO_2	O_2	Illuminants	H_2	CO	CH_4	N_2
Oxygen-air (34 per cent O_2)........	50	32.3	0.9	0.1	6.1	2.1	2.1	56.4
Oxygen-air-steam (32% O_2; 43% N_2; 25% H_2O)..	110	40.7	1.4	0.4	13.2	4.1	4.4	35.8
Oxygen-steam (65% O_2; 35% H_2O)...........	134	59.6	1.9	0.4	18.8	8.6	3.7	7.0

Several runs were made in which steam alone was passed through the mine to determine the quality of gas which might be produced in a cyclic operation, namely, a blow cycle to heat the coke underground and then a make cycle using steam. The average results for four such tests are shown in Table 5.

TABLE 5 GAS OBTAINED DURING STEAM RUNS

Run no.	Duration, min	Btu per cu ft	Per cent by volume CO_2	O_2	Illuminants	H_2	CO	CH_4	N_2
1	135	211	11.4	6.6	0.5	36.6	7.3	5.8	31.8
2	135	319	17.0	..	0.8	54.4	10.6	9.0	8.2
3[a]	90	190	29.3	..	0.2	28.7	17.8	3.4	20.6
4[a]	60	181	33.8	..	0.3	25.2	8.1	6.5	26.1
5[a]	40	146	33.3	..	0.2	14.2	12.1	5.6	34.6

[a] Some leakage of air during sampling; all analyses calculated air free.

Heating values of the gas produced ran as high as 319 Btu per cu ft.

At this point it might also be well to note that before the flow of gas through the mine was reversed, each entry was purged for 2 min with 2000 lb per hr of steam to prevent possible mixing of air and gas to form an explosive mixture. Analysis of the exit gas during the purging run indicated a heat content of 195 to 256 Btu per cu ft. This gas, as would be expected, is roughly comparable with that made during the steam runs.

At the end of 50 days of operation, leakage of air and gas through the coal seam to the outcrop and through the overburden had become excessive even at a blower pressure of 40 in. of water with an air flow of 1200 cfm. Guniting along the outcrop helped a little, but on March 12 it was concluded that conditions were so unsatisfactory that little more could be learned by continuing the combustion.

The mine was steamed for several days and then water run in until it was about 18 in. at the deepest point to cool the mine for examination.

UNDERGROUND EXAMINATION

Three of the observation adits were reopened and a new "southeast adit" extended to the new coal or coke face. A cross-entry was cut completely through the pillar and combustion area, as shown in Fig. 7, in order that the entire cross section could be examined. A center entry was cut into the coal pillar, with adits to the original entries as shown. In addition, the overburden was stripped away near sampling pipe No. 4 to open up the corner for examination.

The roof had fallen down completely and practically all passageways were filled with fused, softened, or broken roof material. In some areas the roof stone had fused and melted, and in others it had become plastic enough to flow down tight on the bottom or over the coke face. There was no caving to the surface, although the cover over this coal was only about 30 or 40 ft. This is explained by the fact that the density of the roof material decreased from about 2.5 before heating to 1.5 after heating. In other words, the expansion of the rock helped to fill voids left by burning out the coal. Doubtless this should also help to force the air flow toward the coal face rather than permit the air to flow through space already burned out.

From the quantity and composition of the gas produced it was estimated that 360 tons of coal were burned, while the underground examination indicated that about 236 tons were burned and 164 tons coked.

Fig. 8 shows the approximate section of burned coal and coked coal at the end of the experiment. It will be remembered that all outer coal surfaces had been covered with clay bags to minimize combustion along these surfaces and to keep it to the center panel of coal. It is evident that this plan was only partially successful.

Fig. 9 shows the section through the cross-entry which was cut for examination. The distance through the coal at this point was about 88 ft. Starting on the east side, coal was encountered for 4 or 5 ft, followed by partly carbonized coal, then several feet of coke which was fingery on the bottom and blocky on the top. Beyond this the fused or softened and expanded roof rock had come down on the coke and floor. Rock of this nature filled all of the original entry and continued through the area of burned-out coal to the coke bed on the center pillar. Following this was partly carbonized coal and then coke. On the west side of the center pillar roughly similar conditions existed to the outcrop.

One of the most satisfactory features of the test was the clean-cut manner in which the coal was burned. There was no coal mixed with the fallen rock, and the line of demarcation between coke and rock was sharp. The coke was of course formed by the heat that preceded actual combustion and varied from completely coked material at the burning face to partly coked coal. The coke was strong enough to support the roof immediately above it, but due to the marked cleavage of the coal and to shrinking during coking it was very porous. It looked like an excellent bed for the production of producer gas or water gas, providing of course that the air or steam could be forced through or along this bed.

---

[6] The Linde Air Products Company, through its Birmingham branch, co-operated in supplying oxygen, technical assistance, and equipment.

On first thought, it might appear that the collapse of the roof was an unsatisfactory feature. The authors do not take this view, for it seems desirable to fill in as much space underground as possible to force the air or oxygen to the combustion face. To a considerable extent, the fall of the roof helps to do this—at least it cuts down the volume of free space where air can circulate out of contact with coal or coke.

At the end of the underground examination, brattices were placed on the cross-openings and the blower started up to determine if possible the major air paths in the gasification area. Observers equipped with oxygen-breathing apparatus entered the mine and, using anemometers as well as the sense of feel for moving air, reported that the major flow was along the coke-rock interface. This condition existed generally in the areas examined and would seem to be very favorable for the gasification process.

CONCLUSIONS

From this first preliminary experiment, certain conclusions can be drawn as follows:

1 Combustion can be maintained without difficulty, and in a passage of about 300 ft or considerably less practically all oxygen is consumed. This indicates turbulence in the gas stream which brings all parts of it into contact with combustible material.

2 Coking precedes actual combustion and produces a coke bed that should be very satisfactory for producer or water-gas operation, providing the oxygen and steam can be forced through this bed.

3 This experiment shows that coal can be burned and gasified completely underground with little or no loss of combustible material.

4 In this experiment it is doubtful if high enough temperatures or a sufficient area of high temperatures were obtained to secure gas of maximum heat content.

5 The roof will fall (in this case) following combustion of the coke. This does not stop the flow of air or combustion but it does increase the back pressure on the blower.

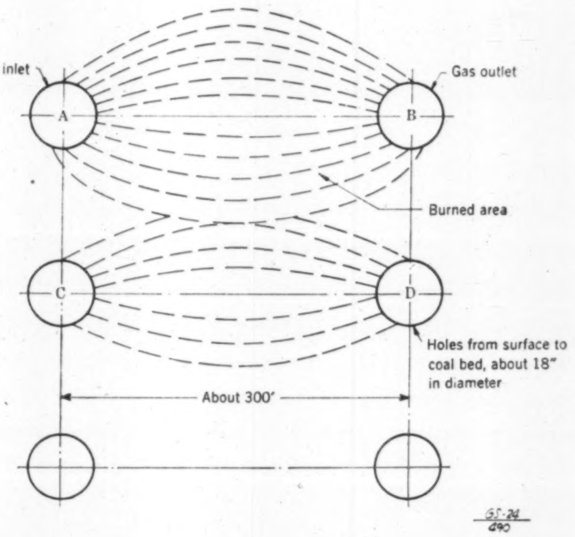


FIG. 10 FUTURE EXPERIMENT ON UNDERGROUND GASIFICATION; HORIZONTAL BED

FUTURE EXPERIMENTATION

In future experimentation it is evident that difficulties such as encountered here can be prevented by working under much deeper cover and far enough from the outcrop to eliminate all possible leaks. The necessary distances can now be predicted quite accurately from this first underground work. To secure high flow of air and increased temperature the blower should have considerably increased capacity and should be capable of operation up to about 2 or 3 atm pressure.

The next test should also minimize the underground preparation work and should be based on a scheme that will allow constant expansion into new coal areas. Many schemes have been suggested to meet these requirements, and one is outlined in Fig. 10. A number of holes about 18 in. diam will be drilled from the surface to the coal bed as shown. The most suitable distance between the holes for underground-gasification purposes will be determined by further experimentation, but those indicated in Fig. 10 will be used at the start. A connecting passage will be drilled or mined between holes A and B and combustion started there with the current of air through this passageway. On the basis of the previous experiment it is believed that the area will burn out in the cigar shape that is shown. Reversal of air flow may not be necessary.

After combustion has traveled far enough toward holes C and D, it is believed that the coal bed will be porous enough to permit flow of air between these holes, and the process between A and B will then be repeated for C and D. If this scheme is successful, underground work would be confined to that needed to start operations, and extension of the process could be carried through the coal area by drilling the necessary holes from the surface.

Certain steps can also be taken from the surface to direct and control the flow of air underground. For example, after the area between A and B has been burned out, blasting may be used to aid in opening air passages between C and D. Moreover, to prevent excessive diffusion of air through the broken roof material, it is planned to pump a heavy slurry of mud or sand into the rock at certain points to force as much air as possible through the coke.

It is hoped that the next experiment at Gorgas, Alabama, can be carried out along the lines indicated near the end of this year.

ACKNOWLEDGMENTS

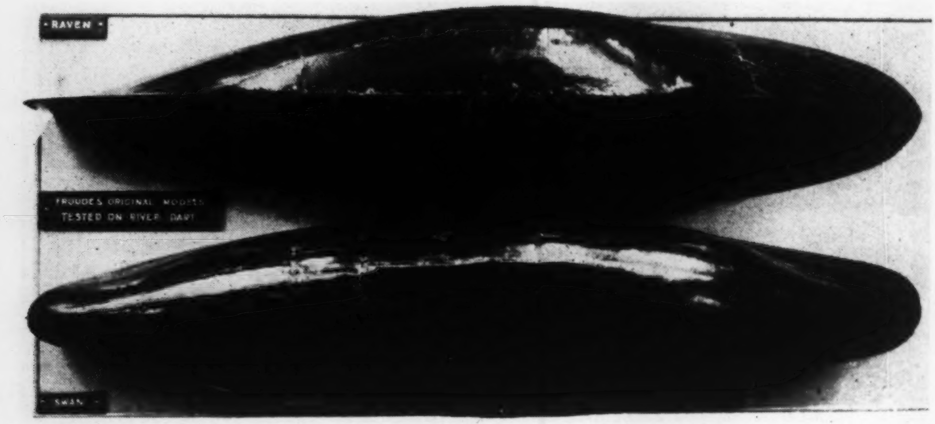
The authors are indebted to Thos. W. Martin, President, Alabama Power Company, for his interest and active encouragement of this work. Without his support the experiment could not have been carried out.

The safety of the men engaged in the operations was supervised by Mr. D. J. Parker, Supervising Engineer, Bureau of Mines, Birmingham, Ala.

The authors are also indebted to the Southern Research Institute for suggestions in carrying out the project and for active participation during its performance.

The planning and general features of the test were developed by the engineers of the Alabama Power Company and the staff of the Fuels and Explosives Branch of the Bureau of Mines. At the same time both organizations contributed as fully as possible to its conduct, and, in particular, the authors would like to mention the efforts of James J. Dowd, James L. Elder, and J. P. Capp of the Bureau of Mines, and Harry M. Johnstone of the Alabama Power Company, who were in immediate charge of the project and spent long hours on the job.

An experiment of this type must of necessity represent the combined thoughts and efforts of a considerable number of men. The authors, therefore, are to be regarded as the members of this group selected to report the work.



THE SIX-FOOT "RAVEN" AND "SWAN" MODELS

THE ORIGINAL FROUDE HULL MODELS

By H. PHILIP SPRATT

THE SCIENCE MUSEUM, LONDON, ENGLAND ASSOCIATE ASME

THERE have recently been placed on exhibition at the Science Museum, London, by courtesy of the British Admiralty, the first experimental hull models made by William Froude in 1867, and tested by him on the river Dart. The results of those pioneer experiments confirmed the truth of Froude's law of comparison, which has since enabled the resistance of ships to be determined from the measured resistance of their hull models.

Two distinctive hull forms, the *Raven* and the *Swan*, were tested by Froude. In order to check the scale effect, the models were made in three different sizes, 3 ft, 6 ft, and 12 ft, in each case, and these were called, respectively, the "small," "medium," and "great." The 12-ft hulls were built of wood and varnished, while the 6-ft models, illustrated herewith, were constructed of sheet iron on a wooden framework. To insure the accuracy of his results, Froude took all possible precautions; he used a pair of 10-ft scale beams connected with self-recording dynamometric apparatus to measure the resistance, and an extremely sensitive screw log to measure the speed of the towing launch.

After his experiments with the 6-ft models, Froude wrote: "I also tried similar experiments with a pair of very nearly similar models of twice the dimensions and eight times the displacement. I had also previously obtained a series of experimental results of the same kind, but with less successful apparatus, from a similar pair of models, three feet long. These data enabled me to compile for each model a diagram of resistance in terms of velocity."

The comparative results of these early experiments were not so close as Froude could have desired, because of an excess resistance of the 3-ft models due to viscosity effects. The 12-ft models also showed an excess of resistance as compared with the 6-ft size, which Froude attributed to certain minor differences in form, and also to some interference from the towing boat. All the elements of hull resistance, he declared, "can be detected, and the laws of their operation discovered with far greater facility and completeness by small-scale than by full-size experiments. And I contend that unless the reliability of the small-scale experiments is emphatically disproved, it is useless to spend vast sums of money upon full-size trials, which after all may be misdirected, unless the ground is thoroughly cleared beforehand by an exhaustive investigation on small scale."

These *Raven* and *Swan* models were later reproduced in "stearine" or hard paraffin wax at the Admiralty Experimental Establishment by the methods which have since become standard practice. The *Swan* was the first bulbous-bow model from which reliable test results were obtained. Similar bulbous bows have since been fitted to battleships, cruisers, and destroyers. The pioneer work of William Froude (1810–1879) has borne abundant fruit. In 1894, his methods were adopted by Sir Charles Parsons, who made and tested a 6-ft experimental hull model[1] of the *Turbinia*. Experimental tanks are now established in most parts of the world where ships are built, and Froude models are tested as routine practice for the scientific development of hull form.

WILLIAM FROUDE, 1810–1879

---

[1] "Sir Charles Parsons and the Turbinia," by H. Philip Spratt, MECHANICAL ENGINEERING, vol. 69, July, 1947, p. 585.

Long-Range INDUSTRIAL PLANNING

By D. C. PRINCE

VICE-PRESIDENT, GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y. MEMBER ASME

ALL during the 1930's this country experienced varying degrees of depression. Then, with our preparedness campaign and later our entry into the war, things began to pick up. Businessmen should not be criticized too severely if to them this pickup of business after such a long depression was construed to mean that, at the end of the war, we might look forward to another depression with further unemployment, and that such conditions might only be alleviated for any considerable time by some other war or threat of war.

When this upswing commenced in 1940, there were still over 8,000,000 unemployed—although our Government had been endeavoring for some eight years to bring us out of a depression. In Germany and Italy, Hitler and Mussolini had tried to provide full employment by various national-planning schemes. In the end they went to war. A general cynicism covered our own land. The rise of prosperity was repeatedly referred to as a "phoney prosperity," and many businessmen and many people in the Government believed that as soon as the war had spent its force, there was almost no likelihood of anything except a return to depression conditions.

A conviction that a similar situation would recur was so firmly rooted that various government spokesmen expected and predicted a similar amount of unemployment even after the war ended, and government policies were definitely predicated on that expectation.

In spite of these fears, a few people did not see any logical reason why we need regard either depression or war as the only possible alternative. It appeared possible in 1941 to make a calculation of the productive potential of the country and from that calculation to see how a high level of production and employment might be realized. In order to make such a calculation, it was assumed that the war would run an indeterminate number of years and that upon the termination of the war two years might be required to reconvert our industries from war to peace. Since it was necessary to have an actual year in mind, in order to calculate the population available for work, the year 1947 was selected, more or less at random, on the assumption that war would end in 1945. Actually, of course, the war did end in 1945, so that the two years have now elapsed. Our reconversions are practically complete, and therefore it should be possible to analyze the accuracy with which such analyses were made at that time.

STATUS OF THE LABOR FORCE

As a preliminary step in determining the labor force, it is possible, of course, to predict the population at any given time simply by assuming the birth rate. In so far as the labor population at the close of 1947 is concerned, all those people were alive in 1941, when the calculations were made, so that it was only necessary to assume that the country would not be decimated. The fraction of the population entering the labor market in peacetime is a matter of record; and, for the purpose of such a calculation, therefore, the highest fraction of the peacetime population previously employed was assumed as the fraction which would be employed under the postwar conditions.

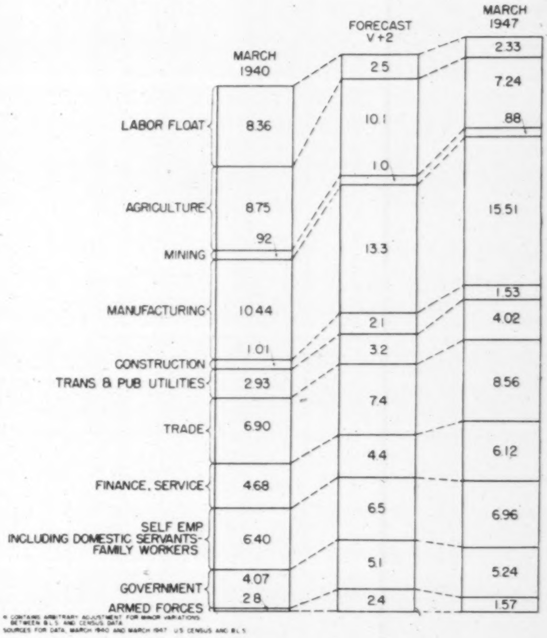


FIG. 1 COMPARISON OF EMPLOYMENT FORECAST WITH ACTUAL 1947, IN MILLIONS

The productivity per individual worker was assumed to be the same as immediately before the war, the theory being that, during the war, although productivity of war items might greatly increase, still the reconversion period back to things of peace which had not been made during the war would find the efficiency of production on approximately the same level as it had been immediately before the war effort was undertaken. Multiplying the number of the probable labor force by the probable productivity per individual worker, a "gross national product" could be estimated.

Fig. 1 shows the estimate of the labor force. Whereas the unemployed in 1940, numbered something over 8,000,000, the minimum visualized for the year, $V + 2$, was set at 2,500,000. Actually, the record shows that only 2,300,000 were unemployed in 1947. Also, the labor force actually approached the 60,000,000 mark, as compared to the estimate of 58,000,000. This represents a somewhat higher fraction of the total population in the labor force than had been expected, presumably because many, who had started working during the war for patriotic reasons, continued in order that they might have the added earnings. Although the total of the estimate is fairly accurate, there are considerable departures in the distribution, and the question naturally arises whether these departures will con-

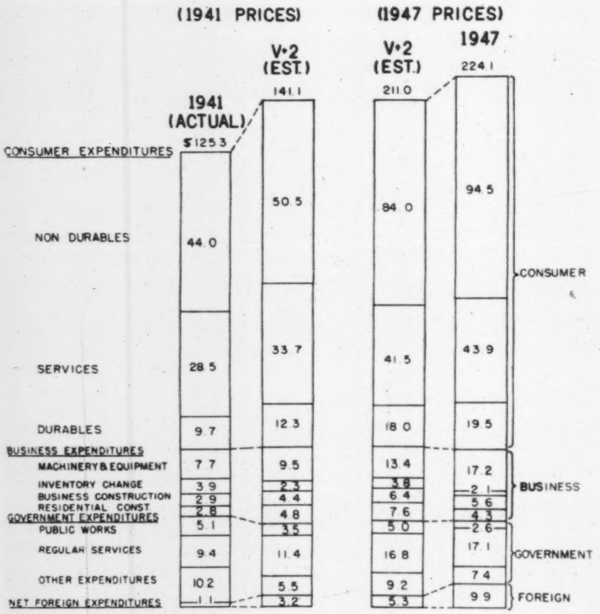


FIG. 2 COMPARISON OF GROSS NATIONAL PRODUCT FORECAST WITH ACTUAL 1947, BILLIONS OF DOLLARS

tinue or whether a further readjustment will take place back toward a more normal distribution of labor.

The most unexpected variation is that the labor force on the farm has shrunk some 28 per cent from the predicted value. It is actually less than it was in 1940. Apparently, a great many of those who went into war industry have preferred to stay in manufacture; and it will be noted that the corresponding figure for those engaged in manufacture is considerably higher than the expected figure. This is probably to be accounted for in some measure by the fact that, immediately after the war, we had very large deferred demands, and it has been necessary, therefore, to manufacture not only for the current year but to make good the deficits of the war years.

THE GROSS NATIONAL PRODUCT OF LABOR

The gross national product resulting from the work of these people appears in Fig. 2. The first column in this chart shows the actual performance in 1941. The second column is the forecast for the year, $V+2$. Acting on the theory that there would be a large amount of unemployment immediately after the war, unless purchasing power were maintained, labor was encouraged to ask for very considerable wage increases. It should have been obvious that there was no immediate need for these wage increases inasmuch as all during the war a great deal more money had been handed out in wages than the people had been permitted to spend on account of the shortage of materials of all sorts. Therefore, these savings hung over the market and, when the wage increases were added to them and the price ceilings were removed, it was inevitable that prices should increase considerably.

Since our estimate of gross national product is based on the man-hours and production per man-hour, it was therefore necessary to make a correction to the "gross national product" resulting from these various price and wage increases. This has been done in column 3. This projection gives a total estimated "gross national product" of some 211 billion dollars. Actually, it appears that the realized figure for 1947 will be approximately 224 billions. The percentage difference between these figures is not large and is accounted for by the following:

1 More people are working than had been included in the estimate.

2 The shift toward manufacturing has been greater.

Analyzing these figures, we find that the sum of government expenditures plus foreign trade—which, in this case, is largely government-sponsored lend-lease or food relief—are very nearly the figures forecast.

Summation of the categories included in business also gives nearly the estimated figure.

All of the increase in gross national product, therefore, appears in consumer categories. Consumer durables are very nearly as predicted. Also, consumer services, including rent, are up only a little.

We now see how the realization differs from the prediction, and the question arises whether we have established a new pattern, or the return to the predicted pattern is just not yet complete. The realization of our economic potential is still seriously affected by material shortages.

Fig. 3 lists 18 items in short supply with estimates of the probable dates when the shortages may terminate. One half of the shortages are estimated to end in 1948, but the remainder, including such important items as fuel, grain, and steel, may be with us well into 1950.

In spite of these shortages, the economy is operating at high speed, is producing record quantities of many items, and is reasonably in balance on the production side. Nevertheless, there is a great hue and cry that monopolists, taking advantage of the shortages, are reaping exorbitant profits. Fig. 4 throws some light on that subject.

WHO REAP THE FRUITS OF PRODUCTIVITY?

In this chart gross national product is divided between government receipts, business net receipts, and individual net receipts. We see that over the years, while government's share has increased over 80 per cent, business' share has gone down 30 per cent and individual's share only 6 per cent. This does not sound like exorbitant profit increases, and the relative figures of corporate to individual receipts do not look excessive.

Moreover, Fig. 5, further subdividing the receipts of individuals, shows that the share in wages and salaries did not go down at all but rather went up, as did the incomes of farmers

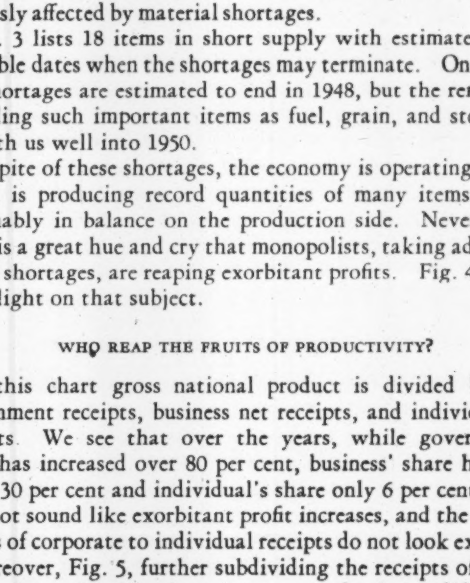
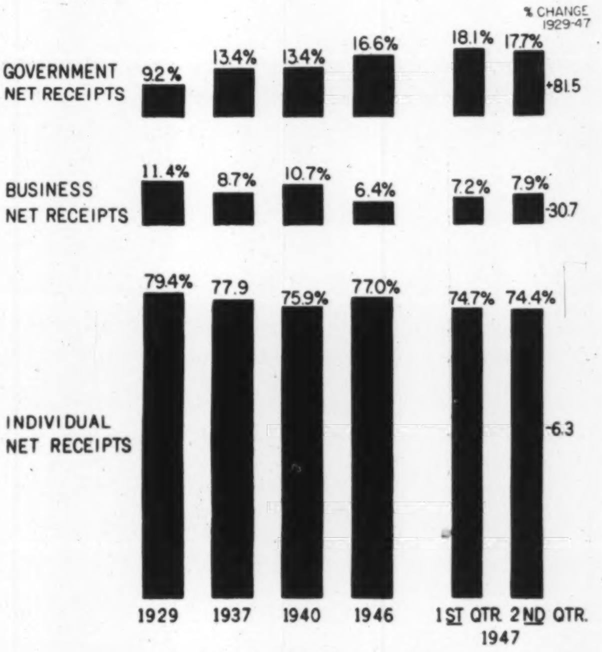


FIG. 3 SCARCITIES

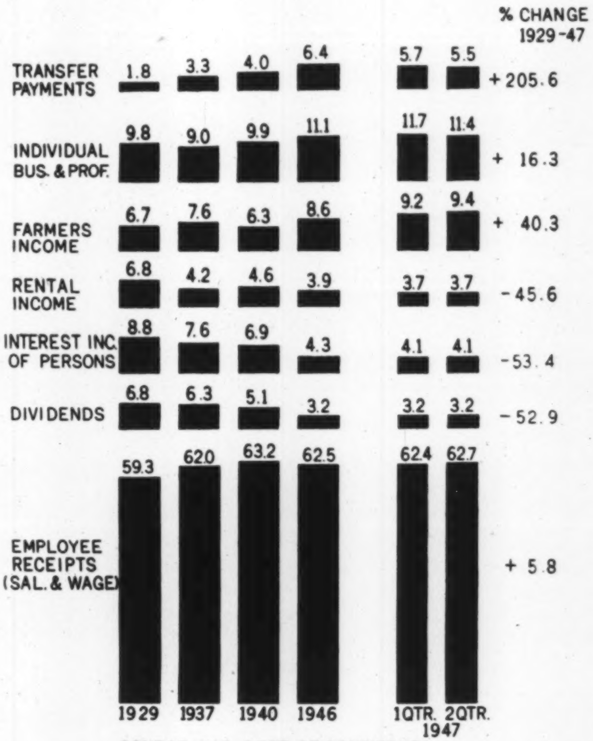
and professional men. The losers were the recipients of interest, dividends, and rent. It is clear that business and the recipients of dividends, interest, and rent are the people with a justifiable complaint.

However, returning to the make-up of the "gross national product" and particularly to the expenditures of individuals, we find, as stated before, that consumer durables are about as predicted (see Fig. 6). They constitute between 10 and 12 per cent of the "gross national product" and are within those limits now. Savings are still above normal rate; but, services, including rents, are off nearly one third. A disproportionate amount of effort is going into nondurables. In Table 1, the distribution of the consumer dollar is further detailed. Only two radical departures from the norm appear, and these are rents, which are down, and food which is up.



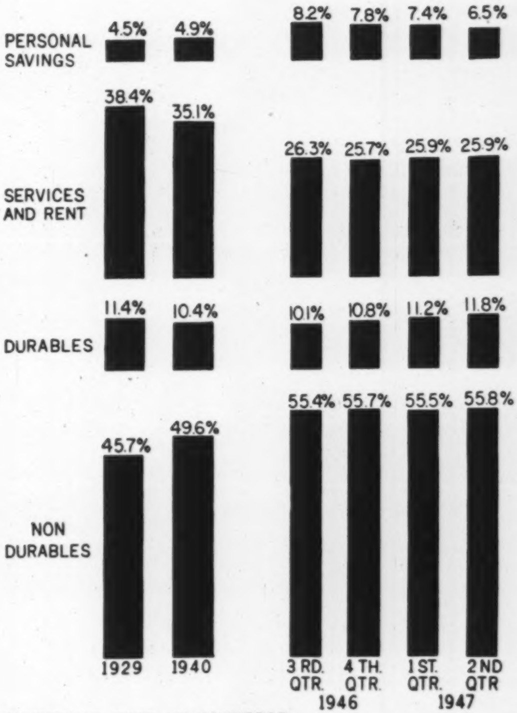
SOURCE U.S. DEPT. OF COMMERCE

FIG. 4 PERCENTAGE DISTRIBUTION OF GROSS NATIONAL PRODUCT



SOURCE U.S. DEPT. OF COMMERCE

FIG. 5 PERCENTAGE DISTRIBUTION OF PERSONAL INCOME



SOURCE U.S. DEPT. OF COMMERCE

FIG. 6 PERCENTAGE USE OF DISPOSABLE INCOME

TABLE 1 PERCENTAGE DISTRIBUTION PERSONAL CONSUMPTION EXPENDITURES

	1929	1937	1940	1946
FOOD	25.0	29.7	28.8	36.0
HOUSING	14.5	12.5	12.8	8.8
HOUSEHOLD OPERATION	13.4	13.9	14.3	12.5
CLOTHES & ACCESS.	14.0	11.9	12.2	15.4
PERSONAL BUSINESS	6.6	5.8	5.3	3.6
TRANSPORTATION	9.5	9.6	9.7	7.6
FOREIGN TRAVEL & REM.	1.0	.7	.3	.3
RELIGIOUS WELFARE	1.5	1.3	1.4	1.1
TOBACCO	2.2	2.5	2.6	2.4
PERSONAL CARE	1.4	1.4	1.5	1.6
MEDICAL & DEATH	4.6	4.8	5.0	4.5
PRIVATE EDUC. & RES.	.8	.9	.9	.7
RECREATION	5.5	5.0	5.2	5.5
TOTAL	100.0%	100.0%	100.0%	100.0%

SOURCE U.S. DEPT. OF COMMERCE

HIGH COST OF FOODS

Why are foods up? One answer is that with consumer durables held at present limits by material shortages and rent held down by rent control, the people just do not have anything else to spend their money for.

However, this is too crude a way to look at the food situation. Obviously, part of our food problem results from the fact that we have been exporting large amounts of food to needy Europe. World food production is definitely subnormal. As a result, world food consumption is something like 10 per cent below prewar and 2 per cent or 3 per cent below 1946. Yet, in spite of war losses, the world population is up some 8 per cent since prewar days.

In 1946 we exported 18.5 million long tons of foodstuffs, something like 8 per cent of our total production. In other times this exportation of foodstuffs amounted to nearly 500 trillion calories—or enough to provide approximately one third of the food for 150,000,000 people for a year. This 18.5 million tons compares with an export of 4,900,000 tons in 1939, and an average of only 3,600,000 tons over the period of 1935–1939. Great as these exports have been, however, the fact still remains that they are only 8 per cent of our total production of foodstuffs so that, large as they are, they do not constitute a dominant element in our present high cost of living.

Although we are only proposing to export approximately 8 per cent of the total food production of the country, nevertheless the absolute amount is very large and, coming on top of very large domestic demands, it supplies a serious strain upon our economy. The total 1947–1948 grain supply is estimated at 6,253,000,000 bu. Of this total amount, approximately 900,000,000 bu will be required for industry, seed, and carry-over. A total of 800,000,000 bu are earmarked as food for domestic consumption, and some 4,083,000,000 bu are earmarked as feed for animals. This leaves a total of 470,000,000 bu of grain available for export. The estimated export requirements, however, are 570,000,000 bu, or a deficit of 100,000,000 bu. If we endeavor to get this extra 100,000,000 bu by bidding in the market, obviously the effect on prices would be very inflationary, even though the total figure is only a little over 10 per cent of the total grain supply. On the other hand, the fact that almost two thirds of the total is earmarked as food for animals attracts immediate attention. The 4,083,000,000 bu of grain earmarked for feed would presumably be converted into meat or poultry and dairy products. It is worth while to investigate just what the effect would be if some of our diets were directed toward a vegetarian level and away from a meat diet. Let us look at some of the facts.

TABLE 2 UNITED STATES EXPORTS

COMMODITIES	UNITS	EXPORTS 1939	EXPORTS 1947 EST.	% OF TOTAL PROD. EXPORTED 1939	% OF TOTAL PROD. EXPORTED 1947 EST.
WHEAT	MIL. BU.	77	392	10.4	27.3
CORN	MIL. BU.	32	88	1.2	3.2
MEAT PRODUCTS	MIL. LBS.	193	328	1.1	1.4
EDIBLE FATS (EXCLUDING BUTTER)	MIL. LBS.	228	436	6.6	8.2
DAIRY PRODUCE	MIL. LBS	41	728	4.1	48.0
COAL	MIL. LG. T.	13	48	3.3	7.5
ALL GOODS	DOLLARS				7.1

MOST OF THE CORN NORMALLY PRODUCED IS FED ON THE FARM TO ANIMALS. APPROXIMATLY 25 PERCENT OF THE COMMERCIAL CORN IS EXPORTED.

SCOURCE: U.S. DEPT. OF COMMERCE
U.S. DEPT. OF AGRICULTURE

OUR INCREASING FOOD CONSUMPTION

Before the war, we consumed on the average 3250 cal per person per day. Now, we are consuming at the rate of 3450 cal per day. Before the war, we consumed an average of 2.6 lb of meat per week, whereas now we are consuming 2.94 lb of meat per week. These figures compare with approximately 4.2 lb per week of breadstuffs. Actually, we, are eating some 8 per cent less of potatoes and beans now than we were eating before the war. To produce 1 lb of beef, the animal eats from 6 to 10 lb of grain. A pound of pork represents 4 to 6 lb of grain. A pint of milk represents 1.7 lb of grain; an egg, 9 oz.

Of course, the grain equivalent is not the whole story. However, these figures can all be converted into calories. When a pound of grain is eaten by an animal, a certain part of it is used up by the animal and lost. Therefore, we may set up a series of figures representing the efficiency of feeding the human being by way of grain coming to the human being through different channels. Of our common foods, the most inefficient in this respect is butter. For each calorie we consume as butter, some 39 times as much grain has been expended in the form of grain fed to the cow. This is even after giving due credit to the calorific value of the milk which, when not used as butter, is re-fed to animals. A chicken consumes 18 cal for each calorie we get from his meat. An egg represents 13 cal for every one which we absorb. For beef, the figure is 9; for milk, 6; and for pork, 5. Thus, the pig is the most efficient converter of grain to meat and, even in the case of the pig, 80 per cent of the food value of the grain is lost in the process.

Now, since two thirds of our grain supply is fed to animals—and since, in even the most efficient case, 80 per cent of the food value of the grain is lost in the conversion—the most practical way to stretch our world food supply is to reduce the amount of these animal products which we consume and thereby release the corresponding grain for direct human consumption. Most of the pressure so far has been in the direction of urging people actually to consume less. We in the United States are very well fed compared with practically all other areas of the world. However, any reduction in the calorific input is accompanied by a certain amount of hazard. Well-fed people are much more immune to various kinds of sickness than are those who are on a semistarvation diet. In any event, it does not seem practical to urge the people of the United States to starve themselves in order to help out the starving peoples of Europe when no such step is actually necessary (at least not this year).

DIETARY SUGGESTIONS

To demonstrate this point, we asked a dietitian to prepare two alternative menus. The first represents an amount of meat, eggs, butter, and cream reasonably close to the national average per capita consumption of these products. The second shows a lower meat diet in which careful attention has been given to the proper amounts of all vitamins and minerals. This low meat diet is still above the minimum protein standard required. The total calories provided are actually higher than in the high meat diet. These menus, together with their calorific and other content, are shown in Table 3.

If the whole population were to shift over to this low meat diet, it is possible to show that the amount of grain realized would be about 2,600,000,000 bu, 6 times the total grain exported last year, or 4 times the desired total of grain exports for this year. Under these conditions, 2,600,000,000 bu of grain would be saved out of the total of 4,000,000,000 bu which it is estimated will be fed to animals this year.

Such a drastic change is clearly impractical. In addition to changing the diet of a whole nation—if only 1,400,000,000 bu of grain were required—obviously, farmers would not raise 4,000,000,000. Not only would such a change upset grain production, but it would also drastically reduce the amount

TABLE 3 TYPICAL MENUS AND THEIR CALORIFIC VALUES

Average Meat Menu	Low Meat Menu
Breakfast:	Breakfast:
Grapefruit half	Stewed prunes
2 Eggs with bacon	Oatmeal with milk and sugar
2 Slices toast with butter	2 Slices toast with margarine and jelly
Coffee, cream and sugar	Coffee, top milk and sugar
Lunch:	Lunch:
Cream of pea soup	Cream of tomato soup
Swiss cheese sandwich	Peanut butter and jelly sandwich
Boiled ham sandwich	Egg-salad sandwich
Fresh orange	Fresh orange
Glass of milk	Glass of milk
Evening meal:	Evening meal:
Roast beef au jus	Boston baked beans
Baked sweet potato	Broiled bacon
Fresh frozen asparagus tips	Fresh spinach
Hot roll with butter	Tomato-and-lettuce salad with French dressing
Ice cream with chocolate sauce	2 Slices bread with margarine
Glass of milk	Gingerbread with apple sauce
	Glass of milk

	Standards	Low meat menu	Average meat menu
Protein	47–105 g	90 g	124.0 g
Carbohydrate	280–420 g	402.9 g	312.0 g
Fat	70–140 g	166.6 g	182.6 g
Calories	2800–3500	3388	3349
Calcium	.8–1 g	1.323 g	1.308 g
Phosphorus	1.32 g	1.902 g	1.964 g
Iron	12 mg	34.6 mg	12.9 mg
Vitamin A	3000–5000 I U	26441 I U	10461 I U
Thiamine	2.3 mg	3.96 mg	2.559 mg
Vitamin C	75 mg	139.7 mg	161.9 mg

NOTE: The figures used are based on the daily requirements of a 70-kg (154-lb) man. The variance allowance in requirements is dependent upon the activity of the man. A man of this weight uses from 4–5 cal per kg of body weight depending upon his activity. His protein variance is from $^2/_3$–$1^1/_2$ g of protein per kg of body weight. The carbohydrate variance is from 4–6 g of carbohydrate per kg of body weight.

of fats, hides, and other products available which are required by industry.

The problem, therefore, is to make a shift toward a lower meat diet sufficient to make available enough grain to supply our foreign-aid requirements. Here are some examples which show the amount of shift which would be required.

Before the war, most cattle and hogs were slaughtered when they had attained an economical marketing grade. This grade, often known as "good slaughter grade," was such that the maximum proportion of the fats was consumed by human beings. Today, cattle and hogs are being slaughtered when they have attained a higher grade, often called "choice grade." Much of the additional fat which these animals carry is not consumed by human beings, and in the production of these fats the use of grain is $^1/_3$ less efficient than when the animals are at "good slaughter grades." It is estimated that, by marketing cattle and hogs at prewar weights, we would save about 200,000,000 bu of grain.

Before the war the per capita consumption of meat was 133 lb per annum—today it is 153 lb. A saving of 20 lb per capita per annum would release about 350,000,000 bu of grain.

Thus these two measures alone would provide enough grain to meet any foreign food deficiency we might wish to overcome. In addition, it would mean that Americans would be called upon to reduce their consumption of meats by 15 per cent, still leaving them far ahead of any of the less fortunate people in other countries.

If we were to reduce the amount of milk consumption of the country only 1 pt per person per week, we would release approximately 200,000,000 bu of grain per year, or twice the amount of the indicated deficit. It is clear, therefore, that the way out of the world's food dilemma is not in the direction of belt-tightening but is rather in the direction of going from a high meat to a somewhat lower meat diet.

Actually, since the data for this paper were first brought together, some change for the better appears to have taken place. Apparently, farmers have not been feeding as much grain to animals as was originally estimated, and it appears as though the 570,000,000 bu desired for the 1947–1948 aid program are already on hand. However, the foregoing analysis indicates the direction and extent of any sacrifices which the United States might have to consider in the event that such a program of aid was needed another year and should our own harvest prove to be less bountiful than it has been in the last 6 years.

But relieving a world food shortage is not the only reason for proceeding in the direction of a lower meat diet. In Schenectady the cost per day of the food in the high meat diet is approximately $1.70; that of the low meat diet is approximately $0.90, or only slightly more than one half as much; and this saving assumes no change in prices.

HOW TO BRING DOWN LIVING COSTS

We say we wish to bring down the cost of living. Here is the way to do it. Even if the prices of the articles should remain the same, the use of substitutes for grain-eating animals, such as sheep, fish, or protein vegetables, including many varieties of beans and peas, would bring down living costs. If enough of us reduce our consumption of grain-eating animal products, surplus grain will come on the market and the price will go down. With it will go the price of such meat as we do eat.

But, to return to our major thesis, the totalitarian way to abundance has been tried and failed. Stalin, where he succeeds, is using modified capitalistic methods. Socialism in England is not making a very enviable record. Our own efforts at government intervention have not been entirely successful.

EMPLOYMENT AND PRODUCTION DEPEND UPON COMPETITIVE ENTERPRISE

The only really successful method of achieving high-level employment and production has been the method of a competitive-enterprise system. In the past, that method has been subject to periodic recessions. It is believed we now know how to avoid serious recessions. As a result of postwar planning by businessmen, largely inspired by the Committee for Economic Development, we have avoided the recession that many people inside Government and out were sure would engulf us before now.

The principle of the thing is simple. Estimate what it is thought the country can produce in total and what things the people with the purchasing power will probably choose to buy of free choice. Make and sell those things. If it were not for the labor and detail necessary to elaborate these simple principles, this would sound too easy. Actually, such estimates have never been possible before because of lack of information. The information is available now. It has worked well enough to help us reconvert and get into all-time high-production territory. Now we must steer a course in which we remain faithful to the methods that got us where we are but not get overconfident. We can proceed with confidence, but we must watch for signs of danger.

One obvious sign of danger is an excessive accumulation of inventory in relation to sales volume. Some signs of this character have appeared already. Table-model radios are a good example. Certain makes of refrigerators and washing machines are also in ample supply. While manufacturers of these products, as a whole, are still limited by the availability of materials, mostly steel, all manufacturers are on notice that the rate of production is approaching adequate proportions.

However, the successful application of the relatively simple principles involved in continued high production and employment involves organizing to anticipate a condition of adequate production in advance of the time when excess stocks appear in the store windows. By that time, the only effective course to pursue is to cut production.

Much more success is to be anticipated when it is possible for the majority of concerns to anticipate the likelihood of this condition arising some months in advance of its actual occurrence. Much work needs to be done before such principles are generally applied throughout industry, but large corporations are already building up staffs of economists and market analysts to watch markets and give warning at as early a point as possible of potential overproduction. Much good can also be done by expanding the statistical activities of trade associations so that more data are made available to members at an early date. Finally, government agencies such as the Department of Commerce and the Department of Labor should be encouraged to improve their methods of collecting and presenting data. In addition to the already increasing mass of improved statistics which these agencies provide, private agencies are covering specialized fields by sampling methods.

STATISTICAL BUSINESS STUDIES NEEDED

The project, as a whole, involves a new large-scale problem in communications. It requires the rapid collection, digestion, and dissemination of business information in forms which can be comprehended readily and applied by businessmen to the everyday problems of selling, production planning, and inventory control. It is likely to require a co-operative effort between businessmen, analysts, and engineers to devise the systems by means of which the necessary information can be collected and disseminated with the least disturbance to the ordinary processes of business.

In any year, the total purchasing power created and available to individuals, business, and government is exactly equal to the value of the goods and services produced over-all. To maintain full employment, it is necessary that the specific goods and services produced by those which the receivers of the purchasing power wish to buy.

This increasing mass of data is making it more and more possible for the managers responsible for production to direct it through the channels in the proportion that it will be bought by those receiving the purchasing power. In this way the individual purchaser is king.

Managers and labor thrive in proportion to the skill management uses in predicting the wishes of the customer and in selling him on the idea that his standard of living should go on rising. That, in effect, is the pattern of our competitive-enterprise system. That is the system which has brought us where we are with the highest standard of living of any country in the world. It is the method most likely to keep us there.

Science and the Whole Man

(*Continued from page 117*)

for its benefits are evident to all. It cannot help being tempted to a certain arrogance and a conviction that the keys of truth are in its hands alone. But if education is to meet the test which the crisis of today has put upon it, the sciences must be taught not as a privileged and superior discipline but as parts of a great whole and against the background of all human knowledge. Men of science minister to the world in many ways, but perhaps their most important service now is to join hands heartily with their colleagues in all other fields, assuring our young men today, upon whose shoulders soon will rest such grave responsibilities, that breadth and catholicity of education from which alone can grow the wisdom they must have to save a desperate world.

Today as we look back over a century of our Scientific School we should remember with pride the tradition it upheld so long, of training men in science and nurturing them also in the arts and the humanities. Yale vigorously moves toward this same goal today. No one can leave her doors who has not grown sufficiently familiar with the fruits of the great traditions of the race so that his eyes are opened to their high significance; and everyone is introduced to the principles and concepts which science offers, so that he gains appreciation of this field of human understanding as something more significant than a sterile discourse with material things. We seek to avoid the extremes either of pure technology or of a program fixed so closely on the great ideas of yesterday that it cannot see the assurance of tomorrow.

The second century on which our School now enters is full of peril and of promise—peril that man's mind may now outrun his spirit and bring all down in crashing ruin; promise that mind and spirit may aid and supplement each other so that man, now whole at last, will grow in wisdom and gain full access to the truth along these two great highways. Then only can he achieve a mastery of himself and learn to build the Good Society of which he dreams. Then only can he come to understand the many-sided universe in which he dwells. It is a ***universe***, and though the man of science illuminates one side of it, a poet's insight can reveal the other. We need to listen well to what they both can tell us.

British University Graduates

A RECENT statement of the number of university students in Great Britain, published in *The Economist*, Dec. 20, 1947, reveals that the number of arts students has now increased by some 50 per cent, whereas the numbers studying pure science and applied science have both doubled. With 12,000 more arts students in the universities than in 1939, it is doubtful what immediate jobs they will be able to find in 1948, 1949, or 1950, when the ex-service bulge will be working its way out of the universities. For the present there is no anxiety about the scientists and technologists, for whom some universities report three jobs for every applicant.

It is pointed out that while it is true that the civil service could do with a certain increase in the administrative grade, and that more future administrators are wanted in local government and in the new public boards, these demands are quantitatively small. There are more openings in teaching, and the schools are anxious to recruit more graduates with good degrees. But the large area of new employment must be commerce and industry. Industry needs such recruits, even if it does not yet recognize the need; and from the point of view of the country it is urgently necessary that more men of vision and broad ideas should swell the ranks of industry.

So far, all the expectations aroused by the Barlow Report on scientific man power have been justified, and industry is clamoring for scientists. The Barlow Report however dealt mainly in global figures, and the detailed inquiries into the demand for scientists in particular scientific fields which have followed have revealed large variations. Until the universities are told the detailed requirements, there is a danger of over-expansion and employment difficulties.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

Compiled and Edited by J. J. Jaklitsch, Jr.

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context and credit to orginal sources is given.

Employee-Management Study

THE American Management Association, reporting preliminary findings of a year-and-a-half study of employee participation in increasing industrial productivity, said that the majority of 250 representative companies studied indicated that "on the whole and as a direct consequence of effort at co-operation their labor relations were better in 1947 than in 1946."

The AMA stated that 72 per cent of 182 manufacturing companies throughout the country which have formal programs of employee participation are "pleased" with the work of employee-management committees. Of these, 46 per cent were "moderately pleased" and 26 per cent "keenly pleased."

The Association is studying employee participation in increasing productivity as a possible device for reducing industrial conflict by developing mutually satisfactory methods of achieving the goals of labor and management.

In announcing preliminary findings of the study, it was stated that as labor-management co-operation results in cost reduction it increases the size of the total revenue available for distribution to employees, management, stockholders, and consumers. It was also pointed out that employee participation in management can serve as a vehicle of information to employees on matters of great concern to them, give the employee a satisfaction and interest supplementing the pay check, and become a means of educating employees in the aims and needs of the company.

The study shows that 43 per cent of the companies surveyed which have established a formal program of employee-management co-operation through committees did so because "it is good industrial relations." Twenty-three per cent were prompted by a desire to reduce the cost of production to improve their competitive situation; 13 per cent stated they were responding to government suggestion, and 7 per cent to union pressure.

Approximately 85 per cent of the companies stated that at the time the programs were inaugurated they expected definite increases in productivity to result, while 15 per cent undertook co-operation "just to see what would turn up." Few companies set up any specific objectives.

Co-operation on a departmental basis was shown by the Association's study to be more widespread than on a plant-wide basis. Departmental co-operation was found in 144 of the 182 companies; of these 30 per cent have practiced this type of co-operation for more than 10 years, 15 per cent for less than 2 years, and only 3 per cent have abandoned the method.

Plant-wide committees of union and management representatives were found in 76 of the 182 companies studied. One quarter of these committees have been established since the war, 60 per cent have existed less than 5 years, 33 per cent functioned more than 5 years, and only 10 per cent for more than 10 years.

Some of the company experience seemed to indicate that departmental co-operation made for close relationships between employees and foremen while plant-wide co-operation emphasized better relations between management and unions. It was noted, however, that the importance of the foreman's role in either case is considered so great that 81 per cent of 76 companies with plant-wide committees also have departmental committees which bring employee and foreman together directly.

The AMA also found that co-operation "tends to function best in those fields in which there is already much mutuality of interest." The following ten subjects of most frequent co-operation were listed: accident prevention, furthering understanding of company policy, elimination of waste, attendance, employee insurance plans, quality control, job evaluation, lateness, maintenance of equipment, and physical working conditions.

Other fields of most frequent co-operation included employee health, improvement of methods, training programs, and discipline control. All of these were reported as subjects of successful co-operation by more than 50 per cent of the companies surveyed.

National Security

A NATIONAL Security Resources Board, a new U. S. Government agency, has been created recently by the National Security Act of 1947, "to advise the President concerning the co-ordination of military, industrial, and civilian moblization."

The National Security Resources Board is a permanent civilian agency and reports directly to the President of the United States.

Arthur M. Hill, chairman of the Board, said that the Board will make maximum use of the universities, research institutions, engineering and management firms, professional societies, management, labor, consumer organizations, and private industries, in order to solve its complicated duties.

The major problems of the Board are as follows:

1 Determine the status of national resources in terms of materials, industrial plant, man power, and the other essential factors of our economic life. Determine the essential wartime civilian requirements in event of war, divided as between minimum consumer needs and the necessities for the maintenance and development of our industrial system. The total requirements, both civilian and military, must then be compared with the estimated total potential supply.

2 Continuously review current problems in the light of our economic readiness for a possible war. Such a review will probably result in recommendations to the President on specific actions to be taken to overcome existing shortages prior to any future emergency. Stockpiling of critical and strategic mate-

rials and preservation of our synthetic-rubber plants are cases in point. This is an immediate responsibility of the Board to determine those things that need to be done now, to keep us strong and insure our security.

3 Develop comprehensive and detailed plans to cover the administrative machinery—policies, regulations, organizations, systems, and procedures—that would be necessary in case of war to effectively channel and control production for the war effort and at the same time protect to the maximum possible extent our civilian economy. These plans would cover, generally, the field of the emergency agencies of World War II, such as Office of War Mobilization, War Production Board, Office of Defense Transportation, Office of Price Administration, and the like. Such plans must necessarily be based on many intangibles and assumptions. They must be flexible and kept up to date.

1000-Kw Gas-Turbine Plant

An article in the December, 1947, issue of *Power* reveals that an experimental 1000-kw gas-turbine plant, featuring a new centrifugal-compressor design, built by Maschinenfabrik Oerlikon, Zurich-Oerlikon, Switzerland, had passed its initial tests without difficulty. During the first three months of this year the unit delivered into the Zurich public-utility system a total of 1,200,000 kwhr while operating continuously for some 2000 hr.

Built essentially for research purposes, this open-cycle plant has many more parts than a unit constructed for commercial operation, see Fig. 1. Equipment is arranged to operate as a single-shaft or a 2-shaft machine with the high-pressure turbine driving the 50-cycle generator at 3000 rpm, and the low-pressure turbine driving the compressor at 4500 rpm. Conversion to single-shaft operation takes place by inserting a suitable gear between the two shafts. Various design features are also being tested; for example, the high-pressure turbine has a rigid shaft and the low-pressure turbine an elastic one.

Details of gas temperatures and plant performance have not been released. The plant pressure ratio is 1:4, developed by an intercooled 3-stage centrifugal compressor of unique design. The fuel-injection system is reported to be designed for low-pressure operation needing only a few pounds excess pressure to inject fuel oil into the combustion chamber. This system features fuel nozzles with large cross-sectional areas that have proved to be practically nonclogging.

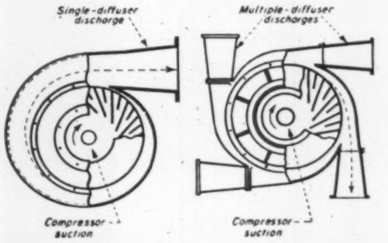


FIG. 2 COMPARISON OF A SINGLE DIFFUSER VOLUTE (*left*) AND FOUR-DIFFUSER VOLUTE AROUND SINGLE IMPELLER IN CENTRIFUGAL COMPRESSOR

A regenerator permits investigating the effect of exhaust-heat recovery and is designed to cause minimum pressure drop. The present unit has only one combustion chamber between regenerator and high-pressure turbine, but for future research a second reheating combustion chamber can readily be installed in place of the conduits now connecting high-pressure turbine exhaust and low-pressure turbine inlet.

Shaft and disk comprising the rotor are made of one piece for each turbine unit. Reaction blades, provided throughout, were selected after considerable experimentation. They have unequal pressure drops through moving and stationary elements. Blade roots were chosen to cause minimum bending of the blades.

To start the plant from rest, motor input equals about 4 to 5 per cent of the unit net rated output. It is anticipated that this can be reduced in future units.

Development of compressors operating at sufficiently high levels of efficiency was the key to making the gas-turbine cycle work. The first compressor to achieve this requirement was the axial-flow type, which subsequently was applied to practical gas-turbine plants, and to most experimental ones. Centrifugal compressors of more or less conventional design showed consistently lower compression efficiencies.

Despite poorer performance, the centrifugals had valuable advantages in a relatively flat pressure-volume characteristic, greater range of operation before reaching the pumping limit, and greater flexibility in intercooler installation without requiring the unit to be split into separate elements. These advantages warranted research effort directed to improving performance characteristics.

Air enters the impeller of the compressor near the center and by centrifugal force is thrown out in a tangential direction from the impeller's outer circumference into the stationary volute. The air leaves the impeller with an increased pressure and a high velocity, see Fig. 2. The function of volute and diffuser is to transform the air's kinetic energy to pressure increase.

But because of the curved path the air must follow in the volute with a single exit or diffuser the outer element of the air stream drags against the volute wall and sets up unequal velocities over any cross section of the air stream in the volute. This results in turbulence and lowers the compression efficiency appreciably. Reduction of this turbulence by minimizing the air drag improves performance.

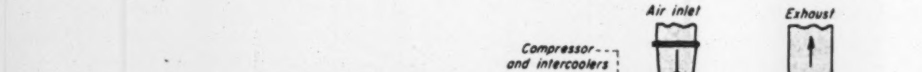


FIG. 1 1000-KW OPEN-CYCLE GAS-TURBINE PLANT

Accordingly, Oerlikon built

three different casings for an impeller; a conventional volute with a single diffuser at exit; a volute with two exits and diffuser; and a volute with four exits and diffusers, 90 deg apart, see Fig. 2. Here, for the single-diffuser casing, air-stream elements must turn from a maximum of 360 deg to a minimum of 0 deg, or an average of 180 deg. For the 4-diffuser casing the maximum and minimum turns are 90 and 0, averaging 45 deg.

Test runs made on the series of casings showed marked performance improvements for increasing the number of outlets in terms of pressure and compression efficiency. With the same impeller, efficiency increased from 76 per cent for one outlet to 88 per cent for four outlets.

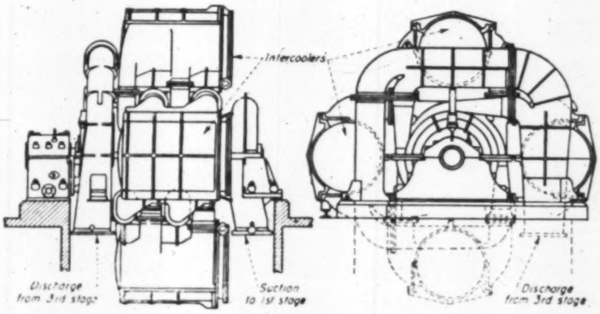


FIG. 3 THREE-STAGE CENTRIFUGAL COMPRESSOR WITH FOUR DIFFUSERS PER STAGE MAKES A COMPACT UNIT WITH INTERCOOLERS FOR AIR DISCHARGED FROM THE FIRST AND SECOND STAGES

Multistaging these compressors with 4-diffuser casings is said to present no problem. The diffuser outlets can be simply connected into a collecting pipe as in the sketch, Fig. 3, for the third-stage discharge, and led into the next-stage suction. Intercoolers can be made an integral part of the machine, as shown. Each intercooler takes care of one diffuser discharge from each of the first and second stages. The cooling-water tubes extend the entire length of each exchanger, which is divided in half longitudinally to accommodate the air of differing pressures.

Largest Land Airplane

THE world's largest land airplane, the United States Air Force's XC-99, built by the Consolidated-Vultee Aircraft Corporation, successfully completed its first test flight at Lindbergh Field, San Diego, Calif., recently, remaining aloft for one hour.

The six-engine giant is a cargo version of the Consolidated Vultee B-36 heavy bomber. Normal crew complement for the XC-99 is five men, plus an equal number of relief-crew members.

Wing span of the XC-99 is the same as that of the B-36, 230 ft. The XC-99, however, is 20 ft longer and 10 ft higher than the B-36, having a length of 182 ft and a height of 57 ft. The 265,000-lb transport is capable of carrying 400 fully-equipped combat troops or 100,000 lb of cargo. Should it be used as a hospital transport, it could transport 335 litter patients with the necessary medical attendants.

The XC-99 is designed for a top speed exceeding 300 mph and a maximum range, with reduced loads, of more than 8000 miles.

Landing gear of the XC-99 consists of two massive main wheels, 110 in. in diameter, a dual-wheel nose gear, and a tail bumper gear, all retractable. The single-wheel main gear is interchangeable with the four-wheel truck gear recently developed for production models of the B-36.

The central portion of the 230-ft wing is $7^1/_2$ ft thick—high enough to permit installation of a catwalk so that crew members could climb into the wing to check engines during flight.

In spite of its size, the XC-99 is directly controlled through physical efforts of the pilot. The control surfaces are operated without the aid of a power boost by a series of spring tabs which enlist the aid of passing air.

Man-Made Blizzards

MAN-MADE blizzards, equaling the intensity of storms experienced in the most remote Arctic regions, are being manufactured at will by engineers in the climatic test chambers of the Signal Corps Engineering Laboratories, Fort Monmouth, N. J.

The Signal Corps' development of actual snow on a continuous basis, and in sufficient quantity to test military equipment under simulated Arctic climatic conditions, is believed to be the first accomplishment of its kind on record.

The results developed by the Signal Corps are considered of major importance as compared with previous snow-making endeavors which were confined to refrigerating machines. These produced snowflakes, but not in the three- to four-inch depth which makes Signal-apparatus testing possible in a chamber large enough to house many men and many articles of equipment.

The made-to-order blizzard is produced in a large low-temperature test chamber, slightly larger than a four-room house and spacious enough to accommodate a large truck and trailer. Its action may be viewed through large multiplane-glass observation windows, specially designed and built to prevent frosting. The temperature is maintained at —40 F by one of the largest low-temperature refrigerating plants in the East using large ammonia compressors powered by over 700-hp electric motors.

A careful preconditioning of the test room precedes the manufacture of snow. This period is of sufficient length to remove much of the heat stored in the air, walls, and floors of the test chamber. Saturated steam at high temperature is then injected into the test room to create an atmosphere saturated with moisture and containing water vapor in suspension which forms a visible cloud or fog.

This cloud rapidly cools to a temperature below the freezing point of water to form a supercooled cloud identical to those found in nature. When the supercooled cloud reaches a temperature of +5 to 10 F nucleation may be induced through the simple process of shaking a small bag of dry ice, about the size of a finger tip, in it. When the cloud reaches a temperature near —40 F the water vapor crystallizes, forming literally billions of microscopic snow crystals.

The hexagonal crystals are carried in the air and immediately collide with other crystals, then pick up still others to form the small snowflakes that pile into a mass of snow that blankets the test-room floor.

With steam vapor continually entering the test room and the temperatures carefully controlled, the snow process is maintained. A minimum of 36 hr of operation is needed to accumulate the snow of worth-while depth and workable quantities for equipment-testing use. In a recent test, snow accumulated over a three-day period of manufacture, completely hid walls and ceilings, and covered the floors and equipment under test to a depth of three or four inches.

High-velocity winds, carrying the fine dry snow particles, are produced by a high-speed motor-driven propeller.

The blizzard-making tests serve a twofold value. Besides providing a reproducible test condition simulating actual Arctic climate found in natural environments, the man-made snow in subzero atmosphere eliminates much of the disadvantages and expense of transporting equipment and personnel to distant locations for on-the-scene tests.

The laboratories' tropical-test facilities can simulate all types of climate up to +190 F with mist, fog, or rain, from a drizzle to two-inch per hour fall. Regional climatic conditions in tropical desert, rain-forest, monsoon, and marine categories are reproduced at will.

In the Arctic climatic tests the temperature range is from +50 F to —100 F, with snow, sleet, ice, or fog.

Gas-Driven Locomotives

THE construction of several natural-gas pipe lines in the vicinity of railway lines has created favorable conditions for the employment of this gas as locomotive fuel in Russia, according to the November, 1947, issue of *The Engineer's Digest* (British edition).

A typical pipe line is that from Saratov to Moscow. It is 850 km in length and delivers 1.5 million cubic meters of gas per day, which is equivalent to 400,000 tons of oil per annum.

To adapt a locomotive to natural-gas fuel, a special tender to carry the requisite number of gas bottles must be provided. The design of such a tender is well advanced, and it is intended to employ an operating gas pressure of 80 kg per sq cm. The bottles would be suitable for an even higher pressure up to 100 to 110 kg per sq cm, but this would require the erection of special charging plants which does not yet appear justifiable.

The operation of a Diesel with mixed fuel (gas plus oil) is based upon the difference in the respective ignition temperatures of oil-air and gas-air mixtures. Through the inlet valve a prepared mixture of gas and air is admitted which has a very high temperature of self-ignition. Toward the end of the compression period a small quantity of oil (10 to 15 per cent of the oil normally injected in full Diesel operation) is injected. This oil ignites and causes combustion of the entire mixture contained in the cylinder. Subsequent phases of the combustion cycle are the same as with straight Diesel operation and it is therefore not necessary to alter the compression ratio when changing over from Diesel fuel to mixed-fuel operation.

Control of the mixed-fuel engine is effected by the action of a speed governor upon both the gas throttle and the fuel-oil pump. Provision is made for starting the engine on oil alone and for limiting the gas supply to 50 per cent of the combined fuel supply when the engine is idling. Load pickup is then effected by increasing the gas supply while the oil supply remains unchanged. Starting of the engine is not therefore different from that of an ordinary Diesel.

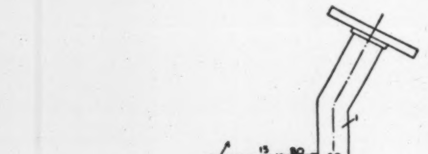


FIG. 4 GAS BURNER FOR NATURAL-GAS-DRIVEN LOCOMOTIVE

The service weight of the tender of a natural gas-driven locomotive is 74 tons. There are 57 gas bottles, each of 11-meter length and 320-mm diameter. Each bottle weighs 870 kg, has a volume of 0.77 cubic meters, and is designed to withstand an operating pressure of 110 kg per sq cm, although the pressure at present is 50 to 80 kg per sq cm.

The firebox of a natural-gas-fired steam locomotive is identical with that of an oil-fired locomotive but the burners are different. There are three gas burners of the type shown in Fig. 4, each one having a capacity of 6 cubic meters per minute. The gas is admitted through the pipe connection (1) and the needle valve (2). Combustion air is admitted through the inlet *A*, the opening of which is adjusted by the disk (3) seated on the nozzle body, and through the register *B* controlled by the damper (4). Gas pressure at the burner nozzle is 1.4 to 1.5 atm, and the excess-air factor ranges from 1.4 to 1.6. To improve combustion conditions in the firebox, either 10 to 15 per cent coal dust or 10 to 15 per cent coal are fired with the gas. The control of gas and air admission is similar to that employed with oil fuel. To increase the operating range without refueling, the ordinary tender, in addition to the special tender, is also provided with 28 gas bottles having a total capacity of 10 cubic meters. With a gas pressure of 50 atm the operating range of the Diesel locomotive is 330 km; and with 110 atm the range is increased to 660 km. In the case of the gas-fired steam locomotive the operating range on gas is 119 km with a gas pressure of 50 atm, and 238 km with 100 atm gas pressure.

Cryogenics

THE extent of research in cryogenics, the science of extremely low temperatures, was brought out during a conference held at The Ohio State University in October, 1947, and is reported in *Science and Appliance*, November, 1947. The Office of Naval Research was sponsor of the Cryogenic Conference. Representatives were present from 15 universities and from government and industrial laboratories. Themes of the conference were in two general classes: Theoretical considerations of energy relationships, and experiences and difficulties with apparatus and observations.

Getting substances to very low temperatures, keeping them there, and observing their behavior is the general nature of the experimental work. Successive stages in reaching low temperatures involve compressing gases (with increase in their temperature and entropy or tendency to pass their heat to cooler substances), cooling them with a refrigerant, and then expanding them. In this way, hydrogen is liquefied and even frozen. Hydrogen melts at 14 K and boils at 20 K. Compressed helium, cooled with liquid hydrogen and then expanded, becomes liquid at 4 K, and its evaporation in a vacuum will reduce the temperature to a little below 1 K. Magnetic methods have been used to go still farther down; certain materials may be robbed of energy by a combination of strong magnetization and refrigeration with liquid helium and reach almost absolute zero when the magnetic field is removed. The nearest to absolute zero reached so far is reported to be 0.0044 K. In the lowest temperature ranges of course difficulties of manipulation and measurement are great.

Like any new development in science, cryogenics now appears highly theoretical. Low temperatures are used as an aid to discovering fundamental properties of matter, particularly energy relationships. After these relationships have been determined, practical applications may be made for such purposes as predicting the properties of metals and alloys and the yields of chemical reactions.

One of the interesting—and probably practical—studies in cryogenics is the phenomenon known as superconductivity. Within a few degrees of absolute zero certain metals and compounds lose all resistance to the passage of electric current.

Extremely low temperatures have been used to advantage in the techniques of x rays and spectroscope for examination of materials. Removing random energy effects from specimens gives spectrographs and x-ray diffraction patterns sharpness and clarity.

The Cryogenic Laboratory at The Ohio State University, set up under the direction of Dr. H. L. Johnston during the war, for studies on the atomic-bomb project, is equipped for studies in the range of liquid helium down to about 1 K. Projects in progress include studies in hydrogen and helium, and physical testing and determination of the properties of a number of substances at very low temperatures. Additional projects involve what might be called by-products from cryogenics proper: research in high pressures and high temperatures, and measurement of the heat of gases. A recent laboratory achievement is the separation of helium 3 (helium of mass three instead of the usual four) which is only one part in one million parts of atmospheric helium and one part in 10 million in gas-well helium. Both He^4 and He^3 have interesting cryogenic properties, and He^3 is important in researches in nuclear physics.

Fast Astronomical Plates

SPECIAL photographic plates made by Eastman Kodak Company, which will be used in the 200-in. Palomar telescope, are said to have emulsions that are four times "faster" than those on astronomical plates in 1928, the year the big telescope project was begun, it was announced recently.

This increased speed or sensitivity to light, according to Dr. Cyril J. Staud, director of Kodak Research Laboratories, is the result of continuous studies to improve photographic emulsions during those years.

Dr. Staud said that faster emulsions today mean that the 200-in. telescope, which is really the biggest camera in the world, will be able to "see" just that much farther into the vast reaches of the universe.

In revealing that Eastman plates would be furnished in various sizes for the huge Palomar eye, he said that some samples had already been sent to the Astrophysical Laboratory of the California Institute of Technology, the headquarters for Palomar research.

He pointed out that because of the wide range of sensitivities in emulsions now available, the plates are not generally stocked but are made to order for astronomers and other scientists in an experimental department of the Kodak laboratories.

Some of the plates for general astronomical use, for example, are supersensitive to red and infrared light, Dr. Staud said. Others, for photographing certain types of stars, are more sensitive to blue. Others react to yellow-green light.

In a large number of cases a spectroscope is attached to the telescope and the resulting spectrographs on the plates tell astronomers about the constitution and motion of the stars.

It is because of the ability of these photographic plates to build up such images through prolonged exposure that the 200-in. telescope will bring new information about outer space, he said.

Some astronomers expect that light from nebulae or great luminous star groups as much as a billion light-years away will be captured on the photographic plates. Others believe it may be possible to photograph clearly such things as the "canals" on the planet Mars.

Dr. Staud said that the photographic plate will be mounted at the top of the tubular framework of huge girders which make up the Palomar telescope or camera. The big mirror, 17 ft in diameter, will rest 55 ft below in a cradle at the bottom of the tube. The mirror will collect the light coming from an object and bring it into sharp focus on the photographic plate at the top.

At the top also, an astronomer-photographer will ride the telescope in a small compartment. Even though the telescope is kept on its target automatically, the astronomer, watching through a smaller refracting telescope, will make certain that the big 200-in. telescope stays on its objective during the long hours of exposure to get the picture.

Coal

TODAY'S need for coal exceeds that of any former peacetime period, it was pointed out by Fred S. McConnell, president, Enos Coal Mining Company, Cleveland, Ohio, at a Fuels Dinner during the 1947 ASME Annual Meeting. He also revealed that in 1947 more than 600 million tons of bituminous coal were produced in this country.

In response to the need the bituminous-coal industry is breaking all peacetime production records, and in 1947 the railroads hauled a million more carloads of bituminous coal than in 1946. It is safe to say that if more machinery, supplies, and railroad cars were available, mine output could be stepped up to an additional million tons per week, he said.

When it comes to the long-range view, he said, we know we have in coal virtually inexhaustible reserves and we have the world's most efficient coal-mining methods to get it out.

Mr. McConnell said further that now is the time for the United States to be thinking seriously about planning a synthetic liquid-fuels industry on an impressive scale. Synthetic liquid fuels can be made from natural gas, coal, and lignite.

By U. S. Bureau of Mines estimates, coal and lignite comprise 98.8 per cent of the United States' mineral-fuels energy reserves, excluding atomic-power elements. Oil shale constitutes 0.8 per cent, petroleum 0.2 per cent, and natural gas 0.2 per cent.

The United States has enormous reserves of subbituminous and lignite in the western regions, and it is toward these that the major oil companies are or should be looking for future supplies of liquid fuels to last for centuries.

A commercial method for making liquid fuels and high-heat-value gas by the Fischer-Tropsch process is being investigated and the U. S. Bureau of Mines is also conducting comprehensive research on liquid fuels from coal.

The future for coal, however, is not limited to what may happen in the development of synthetic fuels, he said. The solid-fuels markets of the future present an encouraging picture.

He cited the $5,000,000 research program to make the gas turbine burn pulverized coal as one of the most significant in all American industry. If the gas turbine burns pulverized coal, he stated—which is indicated—it will have a great potentiality also in stationary and marine power.

He pointed out that for most American railroads, coal costs less than 20 cents per million Btu, while oil costs are approaching 60 cents per million Btu. The coal-burning gas turbine will have a thermal efficiency approaching that of the Diesel while consuming a fuel whose heating energy costs one third that of Diesel fuel.

In the electric-utilities market, which presently accounts for about 14 per cent, he said that since the war ended the expanding demand for electricity has been phenomenal. The number of consumers the past two years has been growing, with some companies estimating the increase to be as large as 10 per cent. Moreover, a larger consumption per user is being experienced. More energy has been needed for commercial and industrial purposes. As the electric utilities expand it means more coal is needed.

The Edison Electric Institute recently announced that the privately-owned business-managed electric-power companies are committed to a five-year construction program that will add 15 million kw to the country's electric-power generating capacity. These additional electric-power facilities will be almost entirely steam plants, fueled with coal, he said.

It is estimated that coal consumed in 1947 by the electric light and power industry reached approximately 86 million tons; in 1948 it will reach 93 million tons; and that by 1950 the coal consumption by the utilities will have passed the 100-million-ton mark.

About 16 per cent of coal's national market is for coking in the manufacture of steel and for merchant coke and city heating gas, along with the coal-tar chemicals. About 95,000,000 tons of bituminous coal were consumed this way during 1947.

As to the future of this market, it should be noted that the steel industry will spend one billion dollars for expanding capacity. Steel cannot be made without bituminous coking coal.

About 20 per cent of the bituminous market is represented by retail merchants' deliveries. Household markets have been losing ground to competitive fuels, although coal-stoker sales have multiplied in recent years. Bituminous Coal Research, Inc., the industry's co-operative research agency, is sponsoring new models of smokeless stoves and furnaces. Field testing with customers is said to show a favorable response.

Of significance, he said, is that Bituminous Coal Research, Inc., increased its membership by 40 per cent in the past two years. It has many research projects under way. The newest project is its Mining Development Committee which is raising $250,000 for developing a machine to cut and load coal automatically in a single operation, underground.

He pointed out that 58 per cent of all bituminous coal from underground operations is mechanically loaded, and 90 per cent is cut by machines. A modern coal mine today is really a co-ordinated mass-production operation underground employing machines, elaborate conveyer systems, and electric railroads.

In 1936 some 477,000 bituminous miners in this country produced 439,000,000 tons. In 1946, 400,000 men mined 532 million tons. Thus after a ten-year span of mechanization, 77,000 fewer men got out 93 million more tons.

Project 3401

A U. S. NAVY rocket expert, Lieut. Comdr. R. C. Truax of the Navy Bureau of Aeronautics, told a joint session of the American Rocket Society and the ASME at the 1947 Annual Meeting, that Navy engineers during the war developed in 45 days of intensive research a liquid-fuel rocket engine able to drive a guided missile at speeds exceeding 500 mph. The missile was known as the "Gorgon." The Gorgon power plant was the forerunner of the engine that powers a present-day missile that cannot yet be discussed publicly, he said.

Reviewing the wartime work of "Project 3401" of the U. S. Naval Engineering Experiment Station, Annapolis, Md., Lieut. Comdr. Traux said the liquid-fuel rocket-development work began in July, 1941, a few months before Pearl Harbor.

The first assignment of the group, of which Lieut. Comdr. Traux was officer in charge, was to develop a rocket unit to assist the take-off of big Navy flying boats. "Jet assisted take-off," or JATO, was intended to increase the carrying capacity of the aircraft and reduce the length of their take-off runs, he stated.

By June, 1942, a motor having 1500 lb thrust had been developed, the largest rocket motor of that time. Concurrently, the Project 3401 personnel conducted pioneer tests on spontaneously ignited fuel combinations, including aniline and nitric acid.

These investigations resulted in a successful rocket JATO unit, the DU-1, rated at 1500 lb thrust for a period of 35 sec, weighing 655 lb with fuel and 325 lb empty. Two DU-1 units cut the average take-off distance of PBY-2 flying boats by 60 per cent.

Another line of JATO research, employing liquid oxygen and gasoline as fuels, had been initiated by a research group headed by Dr. Robert H. Goddard, the American physicist from Worcester, Mass., whose rocket research and developments during the 1920's and 1930's formed the basis of modern rocket designs and principles. Dr. Goddard's unit was the first to be pronounced ready for flight tests.

Lieut. Comdr. Truax summarized successful liquid-fuel JATO projects at Reaction Motors, Inc., with a unit that delivered 3000 lb thrust using a propellant combination of liquid oxygen, gasoline, and water; and a unit made by the Aerojet Engineering Corporation that was used by the U. S. Coast Guard for offshore rescue air operations from San Diego, Calif. Meanwhile, solid-fuel JATO units were being successfully employed in service use at advanced bases.

With the JATO problems tapering off, Project 3401 turned to a new problem—the development of a rocket power plant for a "small, fast, radio-controlled airplane to carry an explosive charge that would destroy enemy bombers." Lieut. Comdr. Truax said the specifications called for a rocket engine delivering 350 lb thrust for two minutes. It was this engine, burning mixed nitric and sulphuric acids and monoethylaniline, that was developed in 45 days to drive the Gorgon missile.

In December, 1945, the Project was moved from Annapolis to form the nucleus of the Propulsion Laboratory of the Naval Air Missiles Test Center now in operation at Point Mugu, Calif.

Threadless Pipe Fittings

THREADLESS malleable pipe fittings, called Flagg-Flow, made for brazed pipe joints, have been introduced to industry by Stanley G. Flagg & Company, Inc., Philadelphia, Pa.

In announcing the new development, it was stated that the threadless fitting simplifies any piping layout and makes it possible to join steel or wrought-iron pipe without threads and without welding by a brazing method any competent pipe fitter can use.

The Flagg-Flow threadless fitting is a black, malleable-iron socket-type fitting for brazing to steel or wrought iron, designed to meet the increasing demand for threadless fittings and also fittings without a chamber. The cup of this fitting is reamed to accommodate the outside diameter of standard pipe and also to produce a shoulder or stop for the pipe when it is inserted. Close tolerances in the machining of the cups insure rigid support and a thorough bond.

There is said to be materially less pressure loss due to friction and turbulence in a piping system using these fittings than in a similar system using threaded fittings. This reduced loss is particularly marked when handling viscous or semisolid fluids, and the design of the fitting reduces the effects of turbulence in the pipe and fitting.

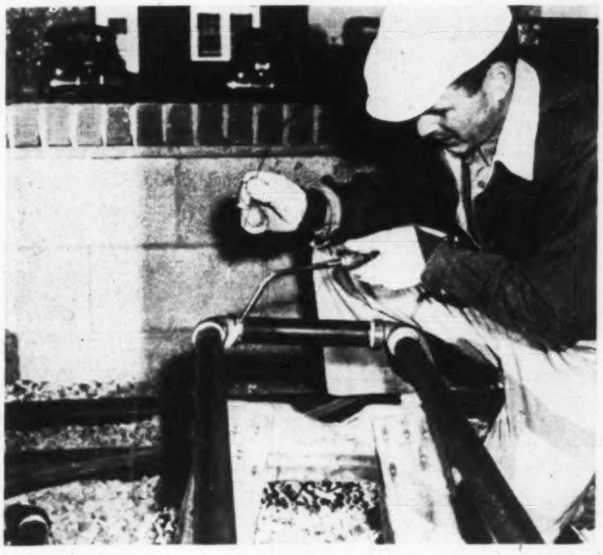


FIG. 5 BRAZING A THREADLESS FITTING

(A simple brazing operation forms a seamless, permanently bonded joint. A radiant-heat installation in a garage at Georgetown, Del., is shown.)

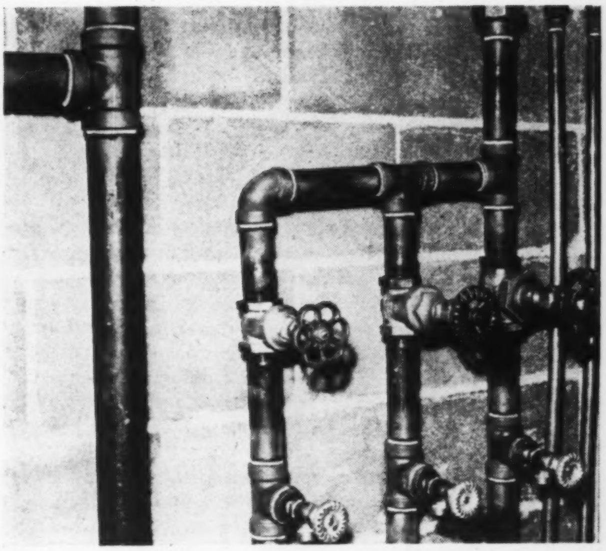


FIG. 6 FOR COMPLEX PIPING

(Threadless malleable pipe fittings are used in a radiant-heat manifold installation at the University of Delaware Agriculture Experimental Station.)

Utilization of the full wall thickness is permitted, and therefore the full strength of the pipe, since no metal is lost by threading. This eliminates the acknowledged weakness of a screwed pipe and fitting installation, and provides an opportunity for reducing, eventually, the wall thickness of the pipe.

Designed for brazing to standard black-steel or wrought-iron pipe, the new fittings are currently made in sizes up to and including two inches, which comprise a large portion of the piping now installed.

The fittings are applicable wherever 150-psi, standard-weight, black, malleable, screwed fittings are now used, that is, for 150-psi working steam pressure at 450 F, or 300 psi, nonshock, oil, water, or gas lines at 150 F.

Company engineers pointed out that, in piping, the ideal has always been to obtain the strength and tightness of a "one-piece" system. Welding has solved this problem to a large extent on high-pressure and high-temperature lines, but it has left untouched the noncritical piping in the bulk of moderate pressure and temperature systems. For these systems, with pipe sizes two inches and under, welding has proved unduly expensive, and it is in these fields that the threadless fittings are said to provide one-piece security and convenience without the cost and difficulty of welding.

It is claimed that the fittings have proved the ability of the joint to withstand much higher rates of vibration than threaded joints, and therefore are advantageous on lines subject to vibration, contraction, or expansion. The threadless malleable fittings are also reported to be of great value in confined spaces where it is difficult, or even impossible, to use a pipe wrench, and in locations inaccessible for maintenance after installation. Similarly, their use is indicated in thin walls and partitions where ordinary bulky fittings would be exposed, and in concrete or cinder-fill flooring, where permanent security is essential as in radiant heating.

It is reported that complete freedom in piping layout is afforded through use of Flagg-Flow joints, as extensive application tests have demonstrated there is no trouble with tight, inaccessible spaces, or with distortion strains in forcing fittings to face properly by wrenching them into position. In effect, no wrench clearance is needed or even jaw space, as the fittings can be faced in exactly the position desired and brazed in that position without trouble. The silver brazing alloy flows by capillary action to form a seamless, permanently bonded joint. It is not necessary to have the brazing torch play at any particular angle around the pipe, and if desired, joints may be made flush against the wall or against each other. No special skill is required for installation which saves both space and physical effort.

Silver brazing alloys melt at 1170 F or higher, therefore an oxyacetylene torch is used to make the joint with these materials. No special equipment is required and normal silver-brazing techniques are employed.

Joints made with silver-brazing alloys are said to be stronger than either the pipe or fitting, as extensive engineering tests reveal that in tension the pipe will fracture before the silver-

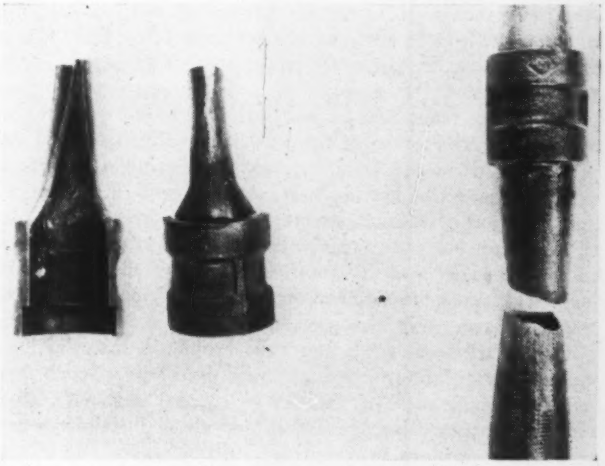


FIG. 7 PHYSICAL TEST SPECIMENS

(These specimens, employing threadless malleable fittings, are made with silver brazing alloys. The tensile specimen pulled at 32,000 lb, which is 65,000 psi.)

brazed joint is damaged, and under hydrostatic pressure the pipe or fitting will rupture before the joint leaks. Similarly, under fatigue tests, failure invariably occurs in the pipe or fitting—not in the joint.

Light-Wave Standard

A NEW and better standard of length now exists in the wave length of green radiation of mercury 198, an isotope transmuted from gold by neutron bombardment. In precision, reproducibility, and convenience, the new standard is said to be superior to both the standard meter and the red line of cadmium, according to recent investigations conducted by the National Bureau of Standards. Preliminary measurements have shown an accuracy of one part in one hundred million of relative values and one part in one billion is theoretically possible.

Since 1889 the world's standard of length has been the "meter" distance between two lines on a platinum-iridium bar at the International Bureau of Weights and Measures in France. Fundamental measurments throughout all of science and industry are based on this standard, but it has several disadvantages. First, line standards are unsuitable in certain fields of measurement; second, the intrinsic nature of lines ruled on surfaces—such lines are in effect small furrows—limits the precision attainable; and third, the meter is not readily reproducible.

Primarily because the standard meter does not afford sufficient precision in some fields, the red line of cadmium has been universally used for many years for precise measurements. However, the cadmium standard also has serious disadvantages. First, there is a fine structure in the red radiation which prevents the line from being as sharp as desirable, and thus limits the precision possible; and second, the cadmium standard requires excitation in a furnace which entails unwanted broadening of the spectral line because of relatively high temperature.

The green line of mercury 198 is said to have none of the disadvantages of either the meter or the red line of cadmium. The normal human eye is far more sensitive to green than to red, an important consideration in visual adjustment of the interferometer with which lengths are measured and compared. All other characteristics desirable in a light-wave standard—such as ability to be reproduced, absolute sharpness of the wave length, intensity of the spectral line, life and convenience of maintenance—are possessed to a greater extent by mercury 198.

The future refinement of physical optics—for example, an accurate determination of the velocity of light, and the improvement of mechanical processes, for example, the ruling of better diffraction gratings—are dependent on the production and adoption of an ultimate standard of length superior both to the meter bar and to the wave length of red radiation from cadmium. The nuclear reaction that now makes possible large-scale transmutation and manufacture of pure elements not found in nature will also produce any desired quantity of the pure mercury from gold, and thus provide a material for a spectroscopic light source that emits light waves much more monochromatic than any emitted by natural elements. Theoretically, mercury isotope 198 should show interference patterns with retardations exceeding a million waves, and because it is possible with monochromatic lines to measure one thousandth of a wave, it is probable that the relative value of mercury 198 wave lengths may eventually be determined with an accuracy of one part in a billion.

It is stated that the wave length of mercury 198 green light can readily be measured relative to cadmium red light from ten to one hundred times more accurately than either relative to the meter. Adoption of the present provisional relation as exact, and subsequent substitution of mercury 198 green for cadmium red, according to the Bureau of Standards, appears to be the logical and expeditious approach to a better standard of length.

Atom-Bomb Explosion

THE effect of a supposed atom-bomb explosion on a typical American city is discussed in an interesting article by Dr. Ralph E. Lapp, Research and Development Division, War Department General Staff, Washington, D. C. In it Dr. Lapp attempts to present a realistic picture of the damage which "City X," an average American city, might suffer were an atom bomb detonated over it.

He points out that the atom-bomb tests carried out in the South Pacific have tended to make the American people rather complacent about the destructive power of this weapon. In evaluating the effects of the bombs detonated at Bikini in the summer of 1946, one must bear in mind that it is difficult to compare damage suffered by ships with that sustained by city buildings. The naval vessels riding at anchor in the Bikini lagoon showed comparatively little damage at more than 1000 yards from the center of blast whereas at Hiroshima buildings 2 miles from the point of the explosion were severely damaged. A ship is not only an extremely strong structure but it is also able to withstand severe shock by recoiling in the water. In contrast, many urban buildings are extremely weak structurally and being rigidly fixed to a massive foundation, they are easily knocked over by a blast wave.

Dr. Lapp discusses such questions as: Just how would an aggressor nation go about atom-bombing City X? What type of bomb would it select? At what point would the bomb be detonated?

The following account of the attack and damages incurred, however, contains the more gruesome facts from his article about the destructive power of an atom bomb, and in so doing Dr. Lapp hopes to stimulate common-sense thinking about the bomb.

It is assumed the attack takes place at noon when the downtown area of City X is most heavily populated.

The city is enjoying a pleasant sunny day with a cooling breeze coming in. The streets are thronged with thousands of shoppers in the downtown and Point Zero (an assumed detonation point) areas. Then suddenly and without warning the bomb is detonated high above the city.

A dazzling bluish-white flash blinds those people on near-by streets and sears them at the same time with its million-degree heat. Almost within a thousandth of a second the small ball of fire shoots out to form a sphere of flame 100 yards in radius. Simultaneously the color of the ball changes, going over to a varicolored seething mass which spreads outward and downward at terrifying speed. Above it all, a huge pinkish white mushroom "atomic cloud" forms and climbs toward the stratosphere.

Directly under the blast, the instantaneous flash of heat sears all pedestrians into unidentifiable charred and grotesque forms. Those shielded from the heat are momentarily conscious of a terrible pressure wave that topples taller buildings and crumbles others into rubble. Within a second a blast wind of near-supersonic velocity rushes in and demolishes those buildings untouched by the primary-blast wave. The air is thick with dust from pulverized buildings and the crashing of surrounding buildings creates a din which is soon followed by the ominous Niagara-like noise of fires ignited by the flash.

To feed the multitude of fires, air rushes in from the surrounding area, even overcoming the prevailing breeze, and so on a firewind of gale proportions sweeps the city. This unusual firewind persists for several hours and makes the entire area near the epicenter inaccessible to what fire-fighting equipment is available. Streets made impassable with debris, the failure of the water pressure, disrupted communications, all prevent fire fighters from reaching the stricken area.

Within a three-mile radius of the epicenter, the number of dead and injured is staggering to the imagination. Those who were within one mile of the blast center, while still surviving, are living on borrowed time. When the brilliant flash of light occurred, those living within a mile of the blast were exposed to a deadly dose of penetrating radiation. Unseen, unheard, and unfelt, these deadly rays penetrated the human tissue and left their mark. Perhaps the survivors would linger for a few days, or even a few weeks but they are doomed.

Much of the enormous damage is due not so much to the primary effect of the bomb but to the secondary effects. In this category, one would list fire damage, injuries due to collapse of fire-gutted buildings, deaths from burns, suffocation, and lack of medical care. Much of the effectiveness of the A-bomb is due to its instantaneous and widespread action. A modern and efficient fire department, such as City X has, can cope capably with a few outbreaks of fire within the city, but when hundreds of fires are simultaneously started miles apart in an impassable area, it is a hopeless task to stem the onrush of the holocaust.

Suppose that the fire burns itself out within the next day and one can then re-enter the area and critically examine the smoldering ruins and evaluate the over-all damage to the area. To make the survey more systematic, let the examination be concerned first with blast damage.

In Fig. 8, the various zones of damage due to blast are shown. Since it is difficult to separate the individual effect of the shock wave from that of the blast wind, their combined effect is considered. From the epicenter to a distance of 1 mile there is heavy blast damage. All frame and brick buildings are demolished and only those sturdy, reinforced-concrete structures on the periphery of this zone escape complete destruction. Within the zone the interior of all buildings is subject to intensive damage.

Both the downtown and the Point Zero shopping centers on the periphery of this zone sustain extensive damage ranging from total destruction to heavy damage. In some cases the walls of the buildings remain standing but the roofs and floors are missing. Able Street is a scene of utter desolation. From the City Hall to Baker Street it is impassable. Streetcars and automobiles, many with their occupants dead inside them, stand out in the rubble-strewn streets. Farther out from the epicenter, within the 1 to 2-mile radius, heavy damage is sustained.

Between 2 and 3 miles distant from the epicenter moderate blast damage is evidenced among the ruins. The majority of the blast damage is concentrated on frame dwellings and plants of light construction. Brick houses in this zone will stand but show some signs of interior damage.

More than 3 miles from the point of bomb detonation there are still signs of blast damage but for the most part they are minor and are masked by damage from fire.

It is possible for blast effects to be felt at as great a distance as 8 miles from the epicenter, but such damage would be slight.

When the bomb explodes a vast quantity of radiant energy (light) is liberated in the form of ultraviolet, visible, and infrared radiation. This radiation causes intense surface heating of all objects which it strikes within a 3-mile radius of the epicenter. In some cases, depending on the local conditions, this surface heating is sufficient to ignite the material. Thus within a circle roughly 6 miles across, there may be hundreds or even thousands of fires started and of these several hundred will persist and spread.

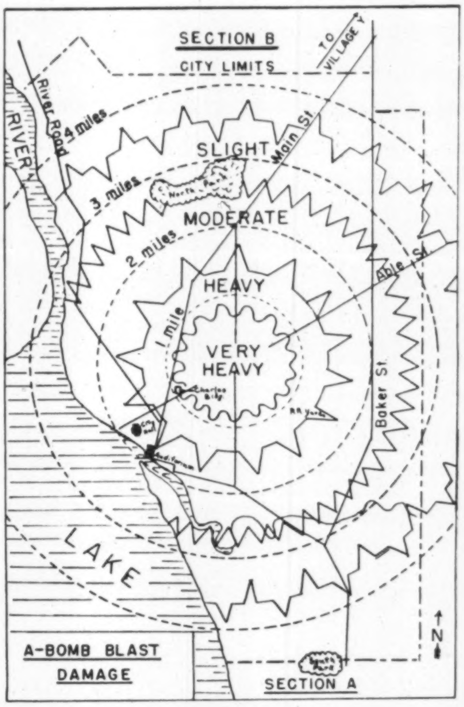


FIG. 8 VARIOUS ZONES OF DAMAGE DUE TO BLAST EFFECT

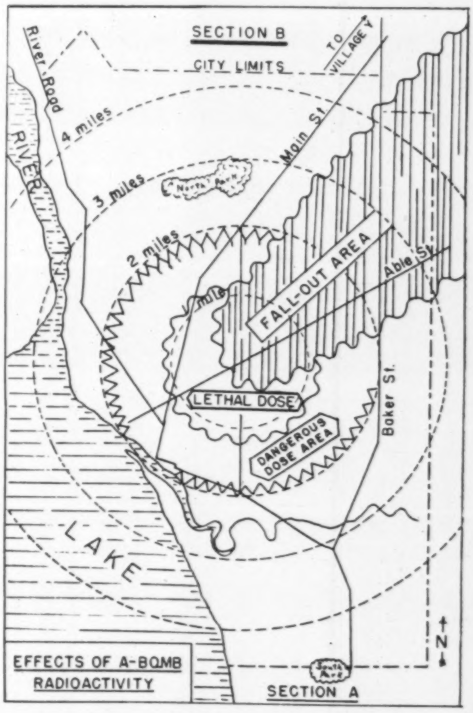


FIG. 9 VARIOUS ZONES OF DAMAGE FROM RADIOACTIVITY

All persons living within a radius of about $1^1/_3$ miles of the epicenter would be exposed to a lethal dose of radiation provided they were not shielded by thick brick or concrete walls, see Fig. 9. A wood-frame wall offers little shielding from this radiation. Therefore most of the people surviving the combined effects of fire and blast in this area would probably die within a few days or weeks from the effects of the penetrating radiation.

Those living in the zone from $1^1/_3$ miles to 2 miles from the epicenter, while not receiving a lethal dose of radiation, would receive a considerable exposure that would complicate their recovery if they suffered any other injuries. Many would show obvious signs of radiation damage, such as loss of hair, but they would later recover and live apparently normal lives.

In summing up the supposed atom-bombing of City X, one can most readily realize the terrific striking power of the new weapon by estimating the total casualties caused by the explosion—about 100,000. Of these, about 50,000 would result in fatalities. The number of fatalities would run as high as this because of the lack of proper medical facilities at the time they are needed most, i.e., the day of the explosion. At Hiroshima there were only a few hospitals in usable condition out of about 50. Of 1780 nurses, only about 100 were available for duty after the explosion.

Dr. Lapp states that in spite of the enormous destructive power of the atom bomb, the new weapon is not an absolute weapon. It remains to be seen just what place the weapon will have in military strategy. From the standpoint of this nation's defense, it is not at all certain that our military position is strengthened by the possession of atom bombs. If one coldly analyzes the use to which these bombs can be put in time of war and one considers that other nations will have the same type of weapons, then it is apparent that our military position is actually weakened by the possession of the bomb. There is also a very real danger that we will delude ourselves into thinking that the atom bomb has given us military superiority over all other nations.

In conclusion, he points out that the answer to the threat of the atom bomb must be found in the realm of world politics. All the forces which we possess must be marshaled in a concerted effort to outlaw war as a means of settling international disputes.

Corrosion Testing

ABOUT twelve years ago, a corrosion-testing project was established at Kure Beach near Wilmington, N. C., which promises better materials for industry and improved equipment for the housewife. To provide more complete knowledge of the effects of salt water and salt air upon metals, wood, plastics, painted surfaces, and even rope, the ocean literally has been placed in a test tube.

The station was established by The International Nickel Company in 1935 for the immediate purpose of comparing the corrosion resistance of low-alloy steels with carbon steel. Soon other materials were added to the program so that eventually comparative tests were being made on all kinds of ferrous and nonferrous metals and alloys.

The testing facilities have since been further extended to observe the behavior of several kinds of protective coatings—both metallic and organic, including antifouling formulations, the effects of marine growth on wood as well as on metals, and even the results of exposure to sea spray and sea air upon rope.

In 1940, facilities for exposing specimens to atmospheric attack were added. In connection with the latter, the Carnegie-Illinois Steel Corporation, The Dow Chemical Company, Magnesium Division, and the American Rolling Mill Company joined Inco in setting up atmospheric-test racks.

The atmospheric-test lot is one acre in area and has room for 40 racks, each of which will support from 700 to 900 specimens. At the present time the number of specimens exposed to the atmospheric tests is about 20,000. This is believed to be the largest number of specimens on test at a single station anywhere in the world. The expense of preparing these specimens for test and caring for them makes the investment in specimens in this test lot amount to more than $200,000.

This is probably a conservative estimate, if the full cost of the specimens is included. Many of these represented special materials at the time they were placed in test, involving special melts and other expensive processing.

Many new materials developed in this country and abroad during the war are now included.

The number of specimens now exposed in sea water is about 2000 and during the past 12 years the number of specimens so tested has been more than 10,000.

Among the advantages provided at the test site are:

1 A continuous supply of full-strength sea water, uncontaminated by industrial wastes, oil films, or other pollution that interfere with tests in harbors or near big cities.

2 A relatively wide range of sea-water temperature (45 to 85 F).

3 A long season of growth of a large number of marine organisms (of particular value in studying antifouling alloys and coatings).

4 Protection against the physically destructive effects of storms and high waves.

5 A fluctuation in water level which permits observation of water line and intermittent immersion effects when desired.

6 Adequate protection to prevent the theft of or tampering with specimens.

7 The availability of personnel and mechanical equipment needed to erect the testing equipment, keep it in repair, and handle the heavy racks of test specimens.

Japanese Reports

Tungsten Resources

A SURVEY report (PB-8074) on tungsten resources of Japan with a brief analysis of the production and exploitation methods used in eight major tungsten deposits is now on sale by the Office of Technical Services, Department of Commerce, Washington 25, D. C.

Between 1931 and 1935, the report states, Japanese annual production averaged 10 tons of tungsten concentrate and 120 tons of ferrotungsten. Between 1941 and 1945 the yearly production average had increased to 290 tons of tungsten concentrate and 1750 tons of ferrotungsten. Of the tungsten concentrate used in industry in Japan proper, domestic mines supplied a tenth of it, imports from Korea three fifths, and imports from other countries the rest. Every effort was made to increase the wartime output of tungsten concentrate from domestic sources but most of the ore was produced at high cost under government subsidies. Tungsten-ore reserves in Japan are small and of low grade, and probably insufficient to meet the requirements of postwar industry, the report states.

All of Japan's tungsten mines and plants for processing tungsten concentrates stopped production in August, 1945, but small-scale operations were resumed at eight mines in 1946. These mines produced 42 tons of concentrates in the first six months of 1946. The concentrates are estimated to contain between 50 and 60 per cent tungsten trioxide.

If Japan can purchase foreign (Korean) tungsten concentrate to fill her industrial requirements, it is almost certain that only two or three of her tungsten deposits could be exploited economically and that the domestic output in any year would probably not exceed 150 tons of concentrate containing 60 per cent tungsten trioxide, the report concludes.

Coal Carbonization

The Japanese development of liquid fuels from the low-temperature carbonization of coal during World War II is described in a report (PB-80744) on sale by the Office of Technical Services.

The low-temperature carbonization of coal, an important source of liquid fuels for wartime Japan, is a process involving removal of a part of the volatile matter in coal by applying heat in the absence of air, the report explains. The temperature is restricted in range from 500 to 700 C to prevent thermal decomposition of the evolved hydrocarbons. The remaining solid product, called "coalite" to distinguish it from high-temperature coke, is much more reactive than coke while the coal tar contains more light fractions than are obtained from high-temperature processes. Since thermal decomposition of the tar is slight, the amount of liquid products obtained is two to three times greater than when the same coal is carbonized at 1000 to 1200 C as in usual coke-oven practice. The gas yield is less but has a higher calorific value.

The coalite produced in Japanese low-temperature carbonization plants is used for domestic fuels, for gasification, as a fuel for portable gas producers on automotive vehicles, and to replace imported low-volatile bituminous coal in making metallurgical coke. Since 1936 one Japanese plant has produced 300,000 tons of coalite for coke blending, and about 2,000,000 tons since 1923, the report states.

Japan made a vigorous attempt to expand synthetic-liquid-fuel production prior to and during the war, including an intensive program to develop hydrogenation and Fischer-Tropsch syntheses. However, between 1940 and 1945 low-temperature carbonization produced seven times as much liquid fuel as the other processes combined—a total of 415,012 kiloliters as compared with 57,611 for the Fischer-Tropsch process, and 1412 for the hydrogenation process, according to the report.

Six types of low-temperature-carbonization systems are used in Japan (Lurgi, Koppers, Mimurs, Shimomura, Wasnishi, and Knowles). The Lurgi system, of German design, is one of the most successful. Each of the systems, as used at various Japanese plants, is described in the report along with flow diagrams, analysis tables, production figures, photos, and other illustrative material.

Magnetic Materials

Four magnetic materials not made in the United States are made by the Japanese according to a report (PB-7603) on sale by the Office of Technical Services. The report surveys the development of magnetic materials in Japan during the war. The subject is of particular interest in connection with the development of magnetic amplifiers, the report states.

The four materials are as follows: an iron-aluminum alloy "Alfor," developed as a substitute for nickel; "Sendust," a high-permeability alloy of iron, silicon, and aluminum; and two permanent-magnet materials, "NKS" and "OP", developed before the war. About 16 other magnetic materials are made in Japan including a few of the high-nickel high-permeability alloys used in quantity in the United States. None of the American magnet material, "Alnico V" is made in Japan, according to the report.

One important new application of magnetic materials in Japan has been the use of Alfer in magnetostriction projectors and microphones. It was also used to replace nickel in the cores of underground vibrators and receivers. The NKS permanent-magnet alloy and the high-permeability Sendust are used in various kinds of apparatus in conventional ways, the report states. OP magnets are used in magnetic chucks, ore separators, telephone receivers, loudspeakers for airplanes, bicycle-lamp generators and the like.

Research, in general, was influenced by Japan's lack of nickel and cobalt. In the manufacture of magnetic materials Japanese methods are said by the investigators to be about 10 years behind those of the United States. For example, silicon-iron transformer sheet is never processed by cold rolling.

However, it is believed that the development of new Japanese magnetic materials may be of interest in connection with American research on the magnetic amplifier or transductor which requires high-permeability magnetic-core materials for efficient operation.

Electron-Diffraction Instrument

A NEW research tool designed to aid in the observation and measurement of surface conditions of metals, ceramics, and plastics has been announced by the Special Products Division of the General Electric Company. Called an electron-diffraction instrument, it is valuable in the investigation of problems associated with corrosion, catalysts, lubricants, metallurgy, pigments, surface deposits, and graphite. It differs from the x-ray-diffraction instrument, which analyzes thick specimens, in that the new instrument shows the crystal structure of surfaces and thin specimens up to 500 Angstrom units.

To operate, a beam of electrons is directed at the specimen being tested, and any resulting diffraction pattern is photographed. The pattern consists of rings whose diameter, intensity, and orientation provide information for determining composition, orientation, and size of the crystals present.

The instrument consists of one unit containing a vacuum chamber with specimen manipulator, visual and photographic recording camera, electron gun and beam-focusing elements, regulated high-voltage power supply, and complete vacuum-pumping equipment.

The specimen chamber permits examination of specimens ranging from 0.1 to 4 in. in diameter. In many cases, the instrument will detect and help identify the very first chemical changes before they are visible under a microscope or are detectable by other means.

Shape Welding

THE methods used in mechanized shape welding—that is, the joining of the pieces of an assembly, in which the direction of the weld changes as the welding action proceeds—were discussed by J. A. Kratz, Unionmelt Division, The Linde Air Products Company, at the 1947 Annual Meeting of the American Welding Society.

There are a number of special conditions which must be taken into account when considering shape welding with the submerged-melt welding process. The welding zone must be maintained in a horizontal plane because of the large pool of molten metal which is a characteristic of this process. In addition, the welding rod must be maintained in the plane of

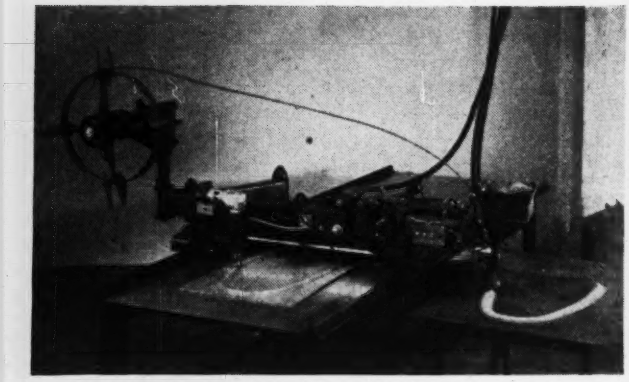


FIG. 10 A TEMPLATE GUIDES THE WELDING HEAD TO ANY DESIRED CONTOUR

the center line of the weld and it must travel at uniform linear speed with respect to the work surface regardless of the shape of the workpiece. Since the process is automatic, the manipulating equipment must be also designed and co-ordinated automatically to meet these conditions.

There are, in general, three kinds of continuous machine welds: straight-line, circular, and irregular. Straight-line and circular welding are the most widely used applications of machine welding. Straight-line welding is performed by moving the welding head along the line of work or moving the work past a stationary welding head. The welding of the longitudinal seam of a tank is an example of straight-line welding in which a mechanized carriage transports the welding head at the proper speed over the work.

Circular girth welds are made by rolling the section under a stationary head. Circular fillet welds are made by rotating the assembly on a positioning mechanism under a stationary welding head.

In straight-line and in most circular welding, the welding head is stationary, or it moves in a single straight line. In shape-welding, the head must move in two, or sometimes three dimensions. Shape welding includes the making of circular welds in the flat plane where it is not desirable or possible to rotate the weldment, irregular shapes in the flat plane, and circular or irregular shapes on curved surfaces.

The method used to make circular welds in the horizontal plane will depend on the size of the weldment. In the welding of large circular pieces, the carriage can be guided by the workpiece itself. An example of this method is the welding of a circular girder.

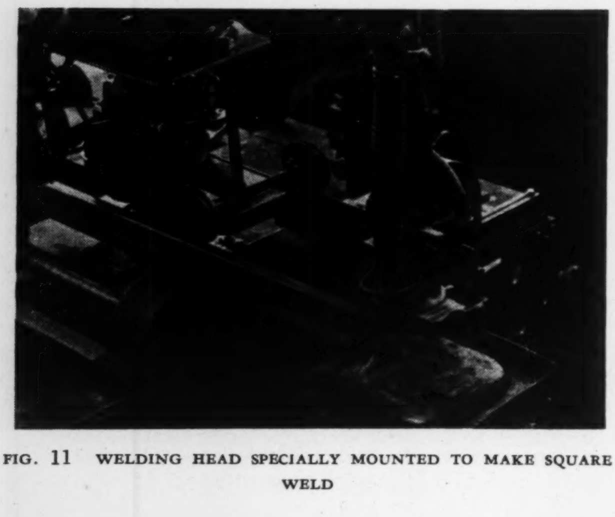


FIG. 11 WELDING HEAD SPECIALLY MOUNTED TO MAKE SQUARE WELD

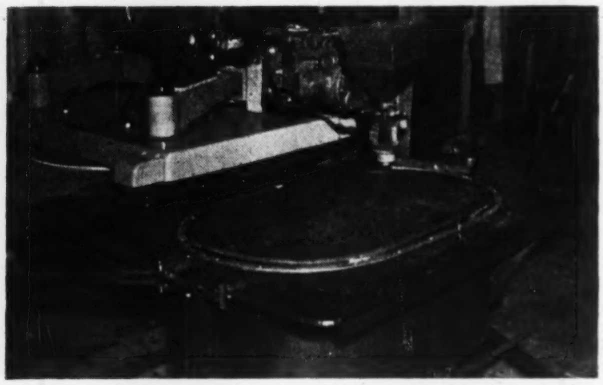


FIG. 12 SHAPE-WELDING FUEL-OIL TANKS WITH A STANDARD TEMPLATE-GUIDED MACHINE

When the circular welds are somewhat smaller in diameter, a radius rod or bar may be fastened to the carriage and pivoted at the center of the workpiece thus determining the radius of the circle the carriage will describe.

For very small pieces the welds can be made by using a motor-driven eccentric pin to swing the welding head in a circle.

For the production of welds of irregular shapes, other methods and equipment are necessary. A machine is needed that can follow any given outline. Machines of the type used for oxyacetylene shape-cutting offer an ideal arrangement, since such machines are made to guide a blowpipe at a uniform speed over almost any pattern. Therefore a welding head can be mounted on these machines and welds of various contours made, using a template for a guide. The laboratory setup shown in Fig. 10 illustrates such an operation.

An adaptation of this method is the making of a square weld to seal the end of marine-boiler headers as shown in Fig. 11. A type-U welding head was mounted on a specially built carriage. The carriage rolled forward and back on one pair of rails. These rails were bolted to a truck which rode on a lower set of rails. This provided freedom in the lateral direction. A magnetic tracing unit attached to the underside of the carriage followed the square template on the table. The welding head was thus driven at constant speed over the square outline required to seal the end of the header.

A manufacturer in the Central States is using a standard machine to shape-weld oval ends to the shells of domestic fuel-oil tanks. The cylindrical shells are pressed into a flattened-oval shape and the flanged ends are manually tack-welded in place. The assembly is moved to the welding station and clamped in postion as shown in Fig. 12. Edge welds seal the ends to the tank. The clamping fixture also serves as retainer for the welding composition.

The problem of making shape welds on a surface that is not flat is principally that of synchronizing the position of the weldment with the equipment that supports and moves the welding head. The outline and size of the piece being fabricated will determine the method that must be used. When an irregularly shaped piece is rotated under a welding head in a vertical plane, two problems are at once evident: First, the weldment must be rotated at varying speeds, since the linear speed will vary as the distance from the center of rotation. Second, because of the irregular outline, the welding head must travel horizontally and be free to move vertically.

One method of solving these problems is shown in Fig. 13. The equipment was set up to weld strips and side plates to the shells in fabricating a large number of Scotch-type marine boilers. To insure constant speed, the welding head was supported on a mechanized carriage. Angle-iron track was fitted and tacked to the surface of the shell. Positive drive of the carriage was obtained by a sprocket mounted inside the carriage which engaged a link chain fastened to the shell. A trunnion mounting supported the entire boiler and provided rotation in the vertical plane. A variable-speed motor automatically positioned the boiler so that the welding zone was always horizontal. A cam-controlled leveling device mounted on the carriage controlled the operation of the positioning motor. Guide rollers are shown riding the welding vee behind and beneath the main cable coupling.

Thus far the only welds that lie in both the horizontal and vertical plane are those in which a circular piece is joined to a larger cylindrical piece. The welding of manhole rings to tank-car casings is an example of this type of weld. The equipment shown in Fig. 14 was used to weld manhole rings which measure $20^{3}/_{4}$ in. OD, 16 in. ID × $2^{3}/_{4}$ in. thick. In this type of weld the problem is to provide the head with vertical movement while it is driven in a circle of the proper diameter. The ring was tacked in place and supported from beneath by jacks. A center-post support was then bolted to the ring. The carriage was lifted vertically by a roller, diametrically opposite the welding head, riding on the shell of the tank. To assist the mechanical lift thus obtained, the welding head was supported on a piston over the center post. A three-way pilot valve admitted air to the cylinder and alternately raised and lowered the welding head as it passed over the contour. A variable-speed motor and gear reducer drove the welding head through a ring gear bolted to the base plate. The vertical travel was approximately $1^{1}/_{8}$ in. It should be noted that the entire tank shell was rolled back and forth as the welding head traveled around the ring so that the welding puddle had no tendency to roll out on the lower sides of the ring.

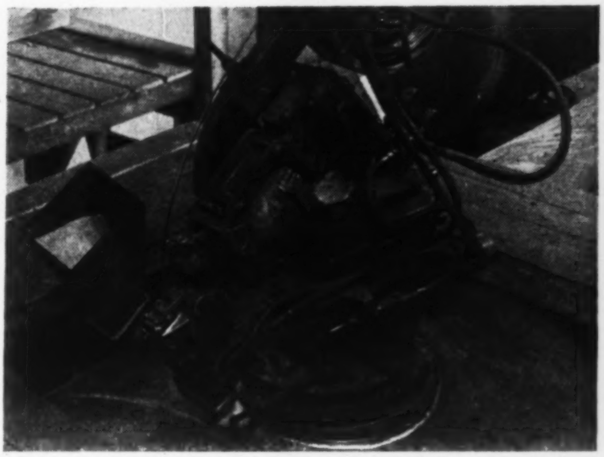


FIG. 14 WELDING MANHOLE RINGS TO LARGE-SIZED TANKS

The welding of domes to locomotive boilers presented a similar problem but it was solved in a different way. Instead of being supported on a central piston, the welding head rested on the work surface. It was tilted in the vertical position and mounted on a small drive unit, as shown in Fig. 15. A vertical post and roller sleeve, riding on a horizontal rod, supported and steadied the welding machine in the vertical position and also supplied the longitudinal motion necessary. As in the previous example, it was necessary to position the boiler under the welding head to keep the welding zone horizontal. A guide-wheel roller, riding in the welding vee, guided the machine.

After completing the weld from the outside, the apparatus was then transferred to the inside of the boiler, and rod track was tacked in place to guide the welding machine. The overhead support was braced to the walls of the locomotive boiler shell so that the entire welding machine was free to turn about the vertical support. A small grooved guide wheel,

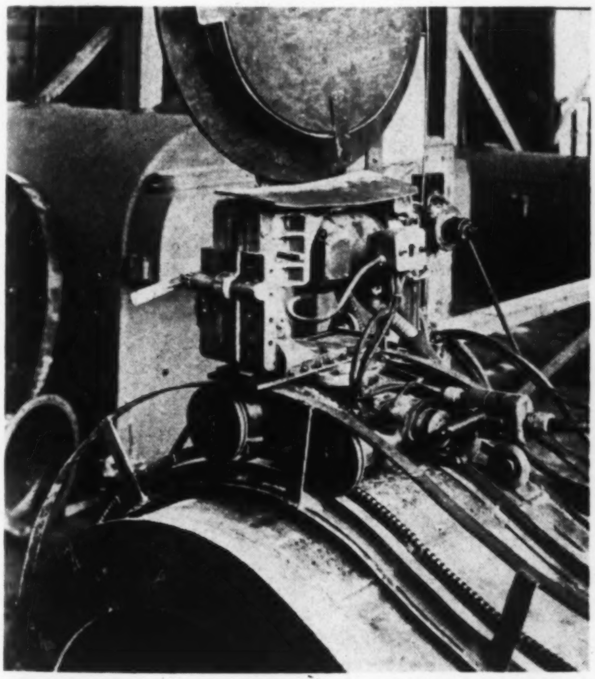


FIG. 13 WELDING SETUP USED ON SCOTCH-TYPE MARINE BOILER

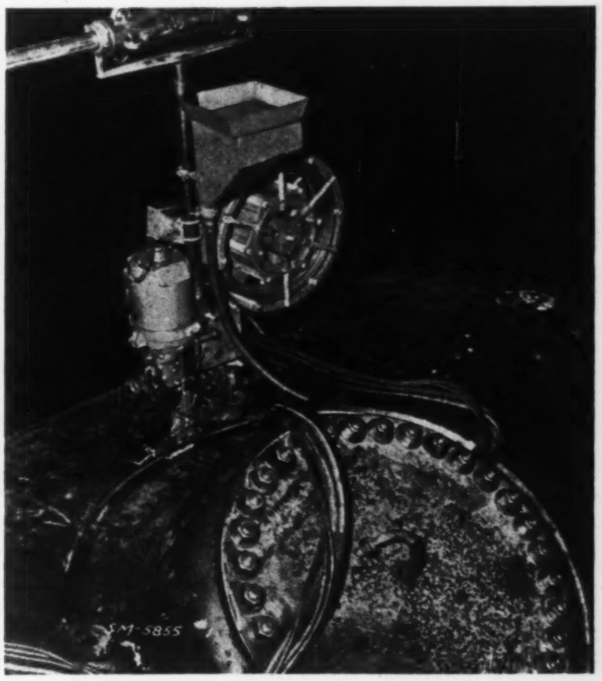


FIG. 15 WELDING DOMES TO LOCOMOTIVE BOILERS

mounted a few inches behind the large drive wheel, kept the welding machine in line with the track.

Supersonic Sound Waves

SOUND waves, beyond the range of the human ear, developed through long research in the science of supersonics, have been found to be lethal when applied to mice and small insects, it was announced recently by the Army Signal Corps Engineering Laboratories at Fort Monmouth, N. J.

Tests for the Signal Corps at Penn State College, State College, Pa., have shown that white mice placed in a sound field died one minute after exposure to the ultrasonic wave.

Autopsies showed that the heating produced by the wave was sufficient to cause death. Mice subjected to only 30-sec irradiations survived, giving the research experts a time-element barometer for lethal exposures to the waves.

Mice, whose fur was removed before the experiment, lived about $2^1/_2$ min in the sound field. Thermocouple measurements, made both internally and externally, showed that the heating produced revealed no obvious damage to the organs of the sonically killed mice.

Other experiments were performed on the common roach and other insects, and in each case it was found that the sonic wave heating was sufficient to cause death. Insects killed by the ultrasonic irradiation included firebrats, yellow-fever mosquitoes, blow flies, meal worms, and caterpillars.

The scientists found that insects could be more quickly eliminated in groups than individually. The experiments produced results of more than biological interest, according to the researchers, giving some indication that the method might be employed in the study of pest control.

For the scientists at work on the supersonics project it was found difficult to put objects into the sound field, or to retrieve them, without encountering burned fingers and hands.

The men do not expose themselves to the direct beam and it is their practice to wear ear plugs. Even then, it has been difficult for them to avoid exposure to the radiated sound. Effects have run from loss of a sense of equilibrium to dizziness.

Supersonics, the science dealing with waves similar to ordinary sound waves, but above the audible range, is not expected to serve any immediate domestic uses, but offers promise in finding and developing more interesting uses which may be applied to industry.

Some time ago it was found that by means of supersonic-wave developments defects in materials could be detected, particularly in metal castings. The reflectoscope is an instrument that makes use of this new-found principle. (See MECHANICAL ENGINEERING, October, 1947, page 849.)

There are three practical ways to generate supersonic waves. One is the use of an air-jet generator, employing much of the same principle as a whistle. (See MECHANICAL ENGINEERING, December, 1947, pages 1041 and 1042.) This method is limited to frequencies below 50,000 cycles. Another method employs a magnetostrictive effect in certain materials, such as nickel, when used with an electric oscillator. This permits power up to 100,000 cycles. A third higher-frequency method employs certain electronic oscillators.

Experts in the study of supersonics feel that the principle has many unknown quantities that no doubt will be brought out through continued research

Recently, techniques were developed in which supersonic frequencies were used in emulsifying or colloidizing liquids by dispersion, such as the method used in producing homogenized milk.

Air Transportation

ACCORDING to a review prepared by the Air Transport Association of America, the U. S. international carriers, during 1947, achieved a safety record excelling any except in those years in which no fatal accidents at all occurred. The passenger fatality rate per 100 million passenger miles is calculated for the year at 1.08 as compared with 3.54 in 1946. On the same basis the domestic fatality rate is calculated at 3.21, as compared with 1.24 in 1946, and with 2.23 in 1945.

With only 5 fatal accidents domestically as compared with 9 in 1946, the revenue-plane-miles flown per fatal accident totaled 65,971,228 as compared with 34,397,826 the previous year. The record also means that each domestic passenger on the basis of the 1947 estimated figures traveled safely by airplane the equivalent of 31,581,704 miles. Internationally fatal accidents numbered 2, both years, bringing the revenue-airplane-mile total for each fatal accident to 44,038,766 in 1947 compared with 29,686,632 in 1946. A passenger could have traveled 94,304,673 miles safely.

The review indicated that increases in traffic volume over 1946 occurred in each category except domestic air mail, and even there the decrease was barely appreciable compared to a year ago.

Outstanding features were a phenomenal increase in air freight, accompanied at the same time by big gains in air express; and a tremendous rise in volume of all overseas operations. International transport of air freight and express by U. S. operators increased 126.9 per cent, while domestic air freight rose 111.5 per cent, and express increased 26.2 per cent.

The year 1947 was marked by concentration of the airlines and the government on safety as the number-one objective, with unequaled progress in the development and installation of both ground and air-borne navigation and landing aids, such as ILS, GCA, numerous other radio and radar devices, and high-intensity approach lights.

The number of aircraft in service reached a total of 961 in December, 1947, of which 793 were operated domestically and 168 to points outside the United States, with many of them used in both services. These figures compare with 809 at the end of 1946, of which 659 were in domestic use and 150 to points outside the United States. The corresponding seating capacity expanded even more sharply, from 23,513 in 1946 to about 31,800 in 1947. Late in 1947 about 60 all-cargo airplanes were in operation more than one third of which were four-engine aircraft.

Feature of the year was the advent of the first new postwar airplane types: the Martin 202, the Douglas DC-6, and the Lockheed Constellation 649 and 749. The helicopter appeared on the air-transport scene with inauguration of air-mail service in California and certification of the first helicopter taxi service in Cleveland, Ohio.

Airplanes on order or option at the end of 1947 totaled approximately 300 with an estimated seating capacity of about 14,500. Chancing production and other conditions made it difficult to forecast how many of these would be delivered in 1948; but it appeared likely that more than half might be in service before the end of the year with the Boeing Stratocruiser and the Convairliner 240 as newcomers.

There were more than 5400 airports throughout the United States late in 1947 as compared with 4490 at the end of 1946, with more than 200 of them having runways of 5700 feet and upward. Certificated airline stops totaled 642, of which 179 had not begun operation because of incomplete construction and other factors. For the first nine months of 1947, scheduled air-carrier use of airports had dropped from 20.44 per cent in 1946 to 15.67 per cent in the face of much greater increase in use by private civilian and Army and Navy fliers.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

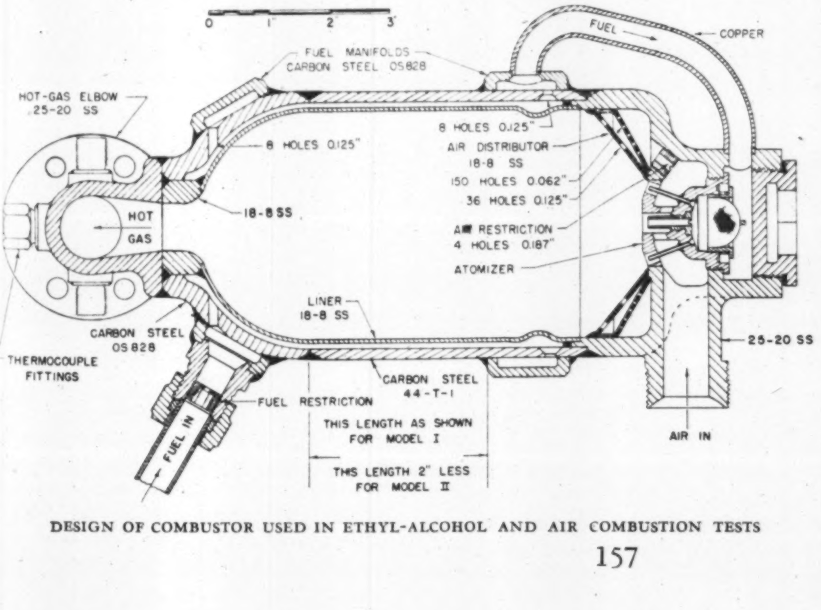
Combustion of Gaseous and Liquid Fuels

High-Output Combustion of Ethyl Alcohol and Air, by A. H. Shapiro, Mem. ASME, D. Rush, W. A. Reed, D. G. Jordan, Massachusetts Institute of Technology, Cambridge, Mass., and G. Farnell, Jun. ASME, Ingersoll-Rand Company, Phillipsburg, N. J. 1947 ASME Annual Meeting paper No. **47-A-25** (in type).

Test results, obtained under sponsorship of the Bureau of Ordnance, are reported for the combustion at 475 psia of air with a mixture of 92.5 per cent ethyl alcohol and 7.5 per cent water by mass. The exit-gas temperature was varied between 1350 F and 2050 F, and was controlled through the introduction of excess fuel. A combustor design which gave combustion intensities up to 11×10^6 Btu/hr ft^3 atm was employed. The experimental relations between gas temperature, fuel-air ratio, isentropic enthalpy drop obtainable from the combustion gas, gas composition, and thermodynamic properties of the combustion gas are given in detail. Theoretical results based upon the assumption of chemical equilibrium at the temperature of adiabatic combustion are in moderately good agreement with the measured results. It is inferred from the data that a condition approximating "frozen" equilibrium sets in at about 2500 F. Two methods of evaluating isentropic enthalpy drop were used and compared, one based principally upon the measurement of thrust, and the other based principally upon gas analyses. Small variations in combustor size and design were investigated. A discussion of the principles underlying the thrust method is given in an appendix.

The Influence of Reaction Interface Extension in the Combustion of Gaseous Fuel Constituents, by W. J. Wohlenberg, Fellow ASME, Yale School of Engineering, Yale University, New Haven, Conn. 1947 ASME Annual Meeting paper No. **47-A-27** (in type).

A burning mixture is, in general, composed of zones, called concentration zones, differentiated with respect to their surroundings by differences in concentrations of the several kinds of molecules present in the mixture. Some of these zones are rich in fuel molecules and others in oxygen molecules. This results in diffusion of oxygen and fuel molecules each from its own concentration zone toward a concentration zone of the other. At the interzone between the two, fuel and oxygen molecules collide with each other in such numbers per unit volume that vigorous combustion ensues, provided that the temperature is well above the ignition point.



DESIGN OF COMBUSTOR USED IN ETHYL-ALCOHOL AND AIR COMBUSTION TESTS

How to Order ASME Papers

PAMPHLET copies of ASME papers referred to in this section are available. Papers published in MECHANICAL ENGINEERING are not included. Coupon Books are available to ASME members at $2 for 10 coupons and $4 for 20 coupons (to nonmembers $4 and $8). Each coupon is good for one paper.

In ordering give title, author, and paper number. State number of copies wanted. Price 25 cents or 1 coupon per copy to ASME members; 50 cents or 1 coupon to nonmembers.

Send check with order to

ASME Publications Sales
Department
29 West 39th St. New York 18, N. Y.

The essential geometrical characteristics of this system to which the energy release rate per unit volume of the mixture is proportional for a given set of conditions otherwise, is the extent of the interzone per unit volume of the mixture. It is shown that the extent factor, in this sense, of the interzone is the area of an imaginary interface within the interzone per unit volume of the mixture.

The foregoing proportionality between extent of reaction interface and reaction rate per unit of volume applies whenever the concentration zones are large compared to molecular dimensions and this proportionality holds under these conditions independently of the mechanism of the processes by which the fuel and oxygen molecules approach the interface for a given set of conditions such as pressure, temperature, and composition. The concept of reaction interface extension thus appears to be of a fundamental nature with respect to reaction rate and combustion progress.

It is shown that inclusion of the coordinate reaction interface extension has an influence on the magnitude of the pressure and temperature effects on the reaction rate for compressible mixtures. This follows because the extension of interface in a unit of volume depends, among other things, on the density of the mixture. It is found also that a large part of the macroscopic effects of turbulence on the reaction rate may be accounted for by the increase in reaction interface extension which results because of turbulence. A large part of the effect of eddy diffusion on the reaction rate is thus accounted for by the increase in reaction interface extension which results because of turbulence.

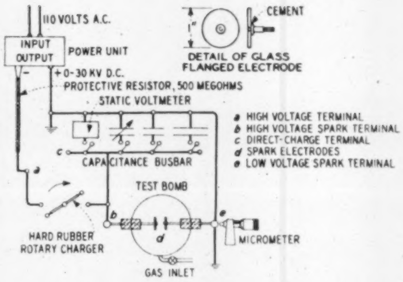
The paper contains the reaction-rate and combustion-progress equations which result when reaction interface extension is included as one of the co-ordinates on which the rate of the reaction per unit volume of the mixture depends. One set of these equations is based on the frequency of effective collisions between fuel and oxygen molecules per unit area of reaction interface. The reaction rate per unit volume of the mixture is the product of the foregoing, times the interface extension per unit volume of the mixture. The combustion-progress equation results by integration of the rate equation over an interval of combustion progress.

These equations are applied to a mixture containing natural gas as the fuel and with varying air-fuel ratios. The results are shown in both tabular and graphical form.

The equations permit also establishment of the order of magnitude of the maximum possible mean energy release rates over a given combustion progress. These maxima should occur when the molecular distribution in the mixture is uniform. It is shown that with natural gas as the fuel, when burned with 1.2 times theoretical air to within 99 per cent of completion, at one atmosphere furnace pressure, this average maximum over this combustion progress is of the order of 2×10^6 Btu per hour per cu ft of furnace volume.

Ignition and Flame Stabilization in Gases, by Bernard Lewis and Guenther von Elbe, Central Experiment Station, Bureau of Mines, Pittsburgh, Pa. 1947 ASME Annual Meeting paper No. **47-A-33** (in type)

The self-ignition of a volume of explosive gas mixture is understood to be the transition from slow to very rapid chemical reaction with approximately adiabatic heat evolution. Two known processes, self-ignition and local ignition, bring this about. They also are distinguished as thermal and branched-chain explosion. In the former, the chemical reaction becomes self-accelerating owing to the temperature rise. In the latter, the self-acceleration is caused by the formation of chemically active particles at a rate that exceeds the rate of destruction of these particles. A peculiar process of the latter type plays an important contributory part in engine knock. Local ignition, as by a spark, results in the formation of a combustion wave which propagates through the explosive mixture in a manner analogous to Huygen's principle for the propagation of a light wave. Small sparks do not produce ignition. The minimum ignition requirement of electric capacitance sparks in mixtures of methane or other hydrocarbons with oxygen and nitrogen is found to be only the spark energy. This is theoretically explained, and the minimum spark-ignition energy is shown to be a function of the burning velocity, the width of the combustion wave, and other variables of the gas mixture in agreement with experimental data. A combustion wave in a stream of explosive gas mixture becomes stationary, i.e., the flame becomes stable when the burning velocity is equal to the gas velocity somewhere in the wave and is nowhere larger than the gas velocity. The mechanism is described by which the condition of equality of burning velocity and gas velocity is realized at the rim of a burner tube. It is shown that the limits for flash back and blowoff correspond to critical values of the gas velocity gradient at the stream boundary. This applies equally to the outer boundary and any inner boundary formed by solid objects in the stream.



SCHEME OF APPARATUS FOR DETERMINING MINIMUM ENERGIES OF IGNITING SPARKS

Metals Engineering

Strength and Failure Characteristics of Thin Circular Membranes, by W. F. Brown, Jr., and G. Sachs, Mem. ASME, Case Institute of Technology, Cleveland, Ohio. 1947 Annual Meeting paper No. **47-A-20** (in type).

The problem treated in this paper concerns the deformation and failure characteristics of thin circular metal membranes and is important because it offers the possibility of investigating the fundamental properties of metal in biaxial stress and strain states.

The instability phenomena encountered in the deformation of such shapes is analyzed in terms of strain distribution and by previously developed equations relating to the stress-strain and radius-strain functions.

The fact is developed that circular-bulge tests appear to be particularly suitable for determining basic stress-strain relations to much higher strain values than are obtainable by conventional methods.

The tests using three different conditions of copper confirmed that an instability occurs in the hydraulic bulging of a ductile circular metal membrane; that this instability is associated with a maximum in the pressure-strain curve; and that the instability strain for a circular bulge can be predicted with good agreement to experimental instability strain by use of the maximum load theory.

Lubrication

Studies in Boundary Lubrication—II. Influence of Adsorbed Moisture Films on Coefficient of Static Friction Between Lubricated Surfaces, by W. E. Campbell and E. A. Thurber, Bell Telephone Laboratories, Inc., Murray Hill, N. J. 1947 ASME Annual Meeting paper No. **47-A-18** (in type).

This paper reports the results of an investigation of the effect of adsorbed moisture film on the coefficient of static friction for commonly employed lubricant types and is the second on this subject by W. E. Campbell. The first was published in Trans. ASME, vol. 61, 1937, pp. 633-641.

It is shown that the extraordinarily high values of the coefficient of static friction between steel surfaces lubricated with straight chain normal hydrocarbons (heptane to decane) are due to a film of adsorbed moisture at the solid-liquid interface.

Friction measurements on a highly refined paraffin-base oil applied to surfaces in equilibrium with a dry and a moist atmosphere, confirm this idea, the coefficient of friction being 0.35 for the dry and 0.6 for the moist lubricated surfaces. Friction measurements are recorded for four fundamentally different lubricant types on steel, brass, and glass in equilibrium with dry air and air of 75 per cent humidity, respectively. The friction is in all cases raised from 40 to 70 per cent in the high humidity, the effects being particularly pronounced on glass.

The results of the tests provide an explanation for many of the discrepancies among oiliness results in the literature obtained by the static-friction method, and indicate that the humidity of the atmosphere plays a significant part in the mechanism of boundary lubrication.

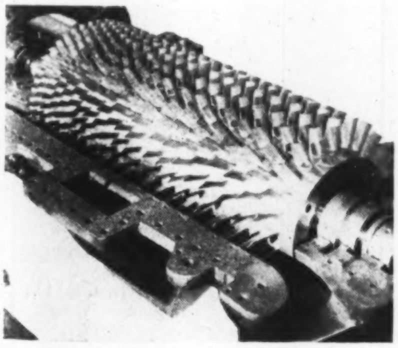
Axial-Flow Compressors

Axial-Flow Compressors for Gas Turbines, by A. I. Ponomareff, Mem. ASME, Westinghouse Electric Corporation, Lester, Pa. 1947 ASME Annual Meeting paper No. **47-A-28** (in type).

The development of the gas turbine during the last decade has opened a new field for compressor application. The compressor is an essential component of every gas-turbine power plant. It delivers air at some elevated pressure to the burner in sufficient quantity to maintain an efficient combustion of fuel and to cool the products of combustion to some acceptable temperature at the turbine inlet. The axial-flow compressor is particularly adaptable to gas-turbine applications for aviation, marine, or land service.

An axial-flow compressor in construction resembles the familiar reaction steam turbine. However, in a steam turbine the blade path is arranged for an expanding or accelerating flow; in a compressor, for a diffusing or retarding flow. In the expanding passage of a turbine the pressure decreases in the direction of the flow, and the boundary layer is continuously supplied with energy to accelerate the gas particles which have been slowed down by friction, thus producing a stable flow. In a diffusing passage of a compressor, the flow is inherently unstable. With a negative pressure gradient, the pressure forces are acting in a direction opposite to the flow, and tend to retard further the gas particles in the boundary layer, producing eddying and backflow.

In an axial-flow compressor, air or gas flows in a general axial direction through a bladed annulus concentric with the axis of rotation. In the rotating row of blades, the air or gas is deflected through a small angle in the direction of rotation. This change in direction of the flow is accompanied by a decrease in relative velocity with resultant pressure rise through diffusion. Because of the unstable nature of the flow in a compressor, only a small change in direction of the flow or pressure rise is possible across a stage. Hence a large number of stages are required to obtain even a small compression ratio. The necessity for small turning angles across a stage compels the axial-flow-compressor designer to discard already developed steam-turbine blades and seek new aerodynamic sections.



NONSYMMETRIC 20-STAGE AXIAL-FLOW COMPRESSOR

While the condensing steam turbine for the pressure ratio of 500:1 or over is in common usage, the pressure ratio above 7:1 is seldom developed in one compressor cylinder without resorting to intercooling.

The operating principles; characteristics; types, such as symmetric or constant reaction and nonsymmetric or vortex; and performance data pertaining to the axial-flow compressor are discussed

---

A Method of Correlating Axial-Flow Compressor Cascade Data, by Hunt Davis, Jun. ASME, Elliott Company, Jeannette, Pa. 1947 ASME Annual Meeting paper No. **47-A-81** (mimeographed).

This paper presents a method of correlating, extrapolating, and interpolating wind-tunnel tests on axial-flow compressor cascades. A method whereby two charts, for the NACA four-digit airfoil series, are constructed and used to determine the "incidence-angle versus turning-angle" curve for any cascade using airfoils of one particular family is described. Such a chart is stated to obviously reduce the need of testing great numbers of different cascades, because it has continuity in all the variables. A limited number of tests covering the range of all variables serve to construct the chart.

In applying the results of any stationary cascade tests to the design of a compressor, the designer must remember that the flow pattern in a stationary cascade is essentially two-dimensional; whereas in the machine there are important three-dimensional effects. These arise directly from the centrifugal accelerations involved, and take the form of radial displacements and vortexes due to boundary-layer formations. These secondary flow phenomena are difficult to analyze, either experimentally or analytically, and many designers choose to lump all such extraneous effects into a correction factor, which is applied to a design method based fundamentally on stationary cascade tests.

The purpose of this paper is to present a new method for correlating the characteristics of airfoil cascades. The two charts developed relate the camber, solidity, and stagger of the cascade, and the entrance angle and turning angle of the flow. When any four of these variables are given, the fifth may be quickly found from the charts.

A simple Prandtl correction is given to correct the solution for a high subsonic Mach number. The profile drag does not enter the correlation scheme directly, but an approximate guide is given on the charts.

The method of constructing the correlation charts is said to appear general enough to be practical for making similar charts for other airfoil families.

Force Measurement

Development of an Air-Operated Force-Measuring System, by A. A. Markson, Mem. ASME, and R. S. Williams, Jun. ASME, Hagan Corporation, Pittsburgh, Pa. 1947 ASME Annual Meeting paper No. **47-A-37** (in type).

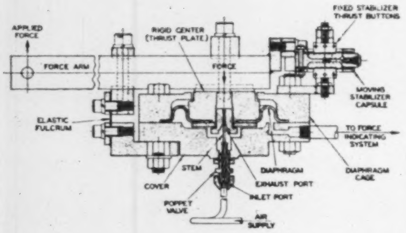
The force-measuring system, known commercially as the "ThrusTorq" system described in this paper, depends upon the principle of using a nonmetallic flexible diaphragm as a null-deflection frictionless measuring piston. This is accomplished by use of a simple auxiliary positioning pneumatic-relay system.

To prevent instability the system uses a viscous stabilizer composed of two diaphragm chambers enclosed by flexible diaphragms which are connected by a small orifice in the partition plate.

Work previously done by the National Advisory Committee for Aeronautics is cited. Because the devices have been used on cradle dynamometers, turbojet engines, rockets, and guided missiles, some essential data relating to the evaluation of such a system and its probable errors are given.

It is shown that the principle utilized in the system is capable of yielding an unusually good combination of ruggedness and stable accuracy.

Several hundred of these units have been placed in service mostly as indicators and recorders on dynamometer systems of various kinds. Industrial applications have been limited to automatic weigh-bin and conveyer operation. Experience with the device points up the advantage of a simple frictional diaphragm system using air and capable of



SCHEMATIC DIAGRAM OF THE THRUSTORQ SYSTEM OF FORCE MEASUREMENT

the remote transmission, control, and recording of force measurements with acceptable accuracy. The fact that the device has been accepted by high-grade laboratories encourages further development.

Hydraulics

Pumping Requirements for Irrigation on Columbia Basin and Central Valley Projects of the Bureau of Reclamation, by Irving L. Wightman, Bureau of Reclamation, Denver, Colo. 1947 ASME Annual Meeting paper No. **47-A-116** (mimeographed).

The history, plan, facilities, and pumping requirements for irrigation of the Columbia Basin Project and the Central Valley Project of the U. S. Reclamation Service are described in this paper.

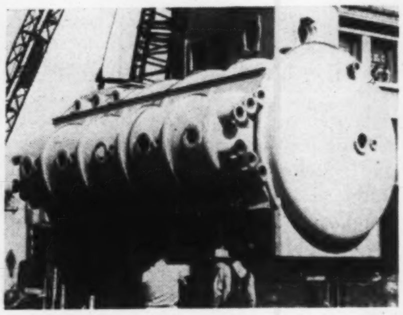
The Columbia Basin Project includes construction of the Grand Coulee Pumping Plant. This plant will ultimately have 12 motor-driven pumping units of unprecedented size. Each pump will have a capacity of approximately 1600 cfs at the low lift of 270 ft and will be driven by a 65,000-hp direct-connected synchronous motor. Water pumped by this plant will irrigate more than one million acres extending from Coulee City south to Pasco, Wash.

As part of the Central Valley Project, the Tracy Pumping Plant is being constructed to raise 4600 cfs, the capacity of an entire Delta-Mendota Canal, approximately 200 ft. In the same project, the Delta Cross-Channel Pumping Plant, designed to lift 10,000 cfs against a head of 7 ft, will probably contain six vertical-shaft motor-driven propeller pumps.

The Hydrodynamics Laboratory of the California Institute of Technology, by Robert T. Knapp, Mem. ASME, Joseph Levy, J. Pat O'Neill, and F. Barton Brown, Mem. ASME, California Institute of Technology, Pasadena, Calif. 1947 ASME Annual Meeting paper No. **47-A-112** (mimeographed).

This paper describes the Hydrodynamics Laboratory and its principal pieces of equipment, and outlines the scope of investigations which it is equipped to undertake.

During the war the Laboratory was operated under contract with the Office of Scientific Research and Development and later for the U. S. Navy Bureau of Ordnance. Among the problems investigated have been the force systems acting on a moving submerged body, mechanism of cavitation, the effect of shape on cavitation, and many others having wide nonmilitary application.



CONTROLLED ATMOSPHERE LAUNCHING TANK BEING LOWERED INTO THE BASEMENT OF THE CIT HYDRODYNAMICS LABORATORY

The Laboratory has an available floor space of 15,000 sq ft and five major pieces of research equipment. These are: a high-speed water tunnel, free-surface water tunnel, controlled-atmosphere launching tank, a polarized-light flume, and a ripple tank.

The paper describes in detail each piece of equipment along with major auxiliaries and tells how each is used in a typical research project. Forty-two photographs and drawings illustrate the paper.

Applied Mechanics

The Absolute Calibration of Electro-Mechanical Pickups, by H. M. Trent, Naval Research Laboratory, Navy Department, Washington, D. C. 1947 ASME Annual Meeting paper No. **47-A-5** (in type).

A new method of calibrating electromechanical pickups is presented in this paper. Given two linear indicators, one of which is bilateral, it is shown that the sensitivities of the units can be established in both magnitude and phase by three experiments which do not involve the direct measurement of oscillating mechanical quantities. It is shown, also, that the technique does not depend upon the specific designs of the units.

A report will be made later concerning the actual development of a set of primary standards and their absolute calibration by reciprocity methods.

A Numerical Solution for the Torsion of Hollow Sections, by E. C. Colin, Jr., and N. M. Newmark, Department of Civil Engineering, University of Illinois, Urbana, Ill. 1947 ASME Annual Meeting paper No. **47-A-7** (in type).

A numerical method for solving directly the problem of the torsion of a bar of constant cross section having one or more internal longitudinal holes is described. The method involves the use of finite differences and can be used with either the iteration procedure due to Liebmann, or the relaxation procedure attributed to Southwell. The method avoids the necessity of combining a number of separate solutions since it establishes the necessary conditions around the hole by a special condition which amounts, in general, to treating the entire hole as a single point in a network, and determining the elevation of this point (i.e., the elevation of the stress function for torsion at the boundary of the hole) by a relation similar in form to that used for regular points of the network. The calculations by this method appear to converge at least as rapidly as for a section without a hole.

Critical Shear Stress of Plates Above the Proportional Limit, by George Gerard, Guggenheim School of Aeronautics, New York University, New York, N. Y. 1947 ASME Annual Meeting paper No. **47-A-11** (in type).

The secant-modulus method previously used for determining critical compressive stresses above the proportional limit has been extended for use in determining critical shear stresses above the proportional limit. The method was confirmed by an experimental program designed to check the use of the shear-secant modulus in the critical-shear-stress-equation. Nondimensional critical-shear-stress design curves are presented for use with aluminum alloys. The test procedure, determination of instability data, test results, etc., are given.

Effect of Bending Rigidity of Stringers Upon Stress Distribution in Reinforced Monocoque Cylinder Under Concentrated Transverse Loads, by Robert S. Levy, Project Stress Analyst, Republic Aviation Corporation, Farmingdale, L.I., N.Y. 1947 ASME Annual Meeting paper No. **47-A-12** (in type).

Least-work analysis of stress distribution in a reinforced circular monocoque cylinder is extended to determine the effect of bending resistant stringers located at the points of application of concentrated transverse loads. Calculations for a numerical example, with applied loads diametrically opposed, indicate that neglect of stringer bending rigidity results in calculated maximum shear stresses approximately 20 per cent conservative in the fields of load application and 50 per cent unsafe in an intermediate field. Further calculations indicate that the bending rigidity of the stringer has less effect when all loads are applied at the same circumferential location. Comparison of shear stresses, calculated by the present method with strain-rosette readings, indicate good agreement.

Effect of a Concentric Reinforcing Ring on Stiffness and Strength of a Circular Plate, by W. A. Nash, University Fellow, University of Michigan, Ann Arbor, Mich., 1947 ASME Annual Meeting paper No. **47-A-15** (in type).

In this study of a fixed-edge circular plate subjected to uniform normal pressure (such as is commonly used on ends of thin-walled cylindrical pressure vessels), it is shown that the maximum vertical deflection, the maximum radial stress, and the maximum tangential stress may all be reduced by reinforcing the plate with a concentric ring.

The bending of a circular plate loaded symmetrically with respect to the center; the twisting of a circular ring by couples uniformly distributed along its center line; bending of a fixed-edge circular plate reinforced by a concentric ring; effect of a ring on deflections; principal stresses in a reinforced plate; the effect of a ring on radial stress; and the effect of a ring on tangential stress are discussed.

Machine Design

Development of a High-Speed Lathe for Machining Aluminums, by R. L. Templin, Mem. ASME, Aluminum Company of America, New Kensington, Pa. 1947 ASME Annual Meeting paper No. **47-A-41** (mimeographed).

This paper describes an experimental turret-type high-speed lathe, for machining aluminum, having a maximum spindle speed of 9000 rpm capable of taking a $2^1/_4$-in-diam bar through its hollow spindle, driven by a special 80-hp motor, together with certain accessory equipment. It describes in detail certain machining experiments conducted with the lathe on two aluminum alloys at cutting speeds varying from 5000 to 20,000 fpm. Various conditions of machining were used resulting in different amounts of metal being removed with a single-point lathe tool up to a maximum of 470 cu in. per min. Data are given for the horsepower required for the various conditions investigated and the results are presented in chart form.

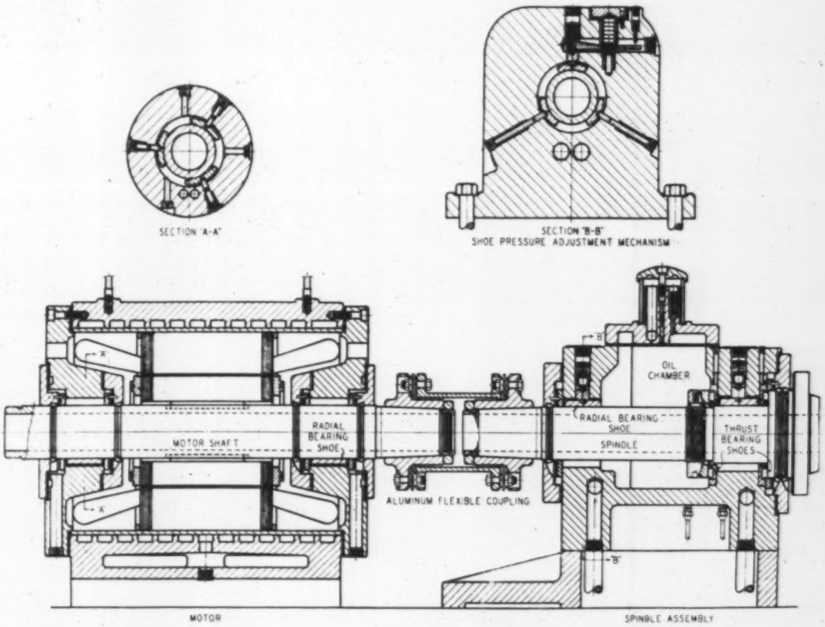
The ability of this machine to remove metal at such fast rates focuses attention on the problems generally associated with chip disposal. The relatively large kinetic energy imparted to the chips by the high cutting speeds can be utilized in their disposal. When the chips are short and broken, suitable shields or guards can and should be used to deflect the chips into suitable receivers or conveyers. When the cuttings are long and continuous, the tools can be designed to direct them away from the work and into a pile or container some convenient distance from the lathe.

Some conclusions have been reached concerning the relationships obtained between efficient metal removal, feeds, speeds, finish, and dimensional control. For instance: (1) Aluminum alloys can be satisfactorily machined by turning at cutting speeds up to 20,000 fpm; (2) the number of cubic inches of metal which can be removed per minute for each horsepower going into the cut is greater for as-rolled 14S than for 14S-T or 24S-T and increases with increasing rate of tool feed; (3) the net horsepower required to remove a given volume of metal is independent of cutting speed and depth of cut; (4) as much as 470 cu in. of metal per min (approximately 47 lb) were removed without overtaxing the equipment; (5) satisfactory machined surface quality can be maintained only if the tools are designed to direct the chips away from the work and prevent them from marring the finished surface; (6) even though the cuts were performed without a cutting compound, the work remained cool and the heat was carried away by the chips; and (7) the maximum condition of unbalance which is permissible in turning with this lathe is that which would produce a centrifugal force of about 700 lb.

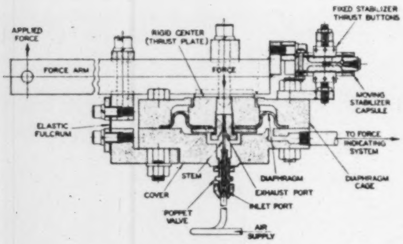
An Analysis of the Dynamic Forces in a Cam-Driven System, by John A. Hrones, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1947 ASME Annual Meeting paper No. **47-A-46** (in type).

The influence of the mass, elasticity, and damping of a cam-driven system upon the magnitude and character of the forces imposed upon the cam are analyzed and discussed from a general viewpoint. Actual solutions for the force-displacement characteristics of three widely used cam contours, gravity cam, harmonic cam, and cycloidal cam, are carried out.

Discussed specifically are the properties of the combined follower-output member system; forces on the cam follower; and determination of cam forces for specific cam contour.



SECTIONAL VIEWS OF HIGH-SPEED LATHE FOR MACHINING ALUMINUMS



SCHEMATIC DIAGRAM OF THE THRUSTORQ SYSTEM OF FORCE MEASUREMENT

the remote transmission, control, and recording of force measurements with acceptable accuracy. The fact that the device has been accepted by high-grade laboratories encourages further development.

Hydraulics

Pumping Requirements for Irrigation on Columbia Basin and Central Valley Projects of the Bureau of Reclamation, by Irving L. Wightman, Bureau of Reclamation, Denver, Colo. 1947 ASME Annual Meeting paper No. **47-A-116** (mimeographed).

The history, plan, facilities, and pumping requirements for irrigation of the Columbia Basin Project and the Central Valley Project of the U. S. Reclamation Service are described in this paper.

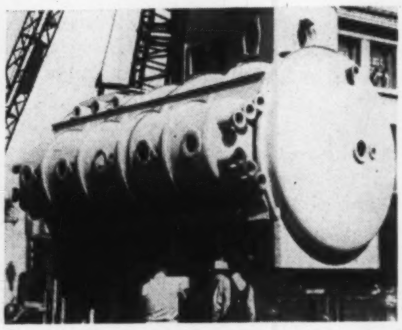
The Columbia Basin Project includes construction of the Grand Coulee Pumping Plant. This plant will ultimately have 12 motor-driven pumping units of unprecedented size. Each pump will have a capacity of approximately 1600 cfs at the low lift of 270 ft and will be driven by a 65,000-hp direct-connected synchronous motor. Water pumped by this plant will irrigate more than one million acres extending from Coulee City south to Pasco, Wash.

As part of the Central Valley Project, the Tracy Pumping Plant is being constructed to raise 4600 cfs, the capacity of an entire Delta-Mendota Canal, approximately 200 ft. In the same project, the Delta Cross-Channel Pumping Plant, designed to lift 10,000 cfs against a head of 7 ft, will probably contain six vertical-shaft motor-driven propeller pumps.

The Hydrodynamics Laboratory of the California Institute of Technology, by Robert T. Knapp, Mem. ASME, Joseph Levy, J. Pat O'Neill, and F. Barton Brown, Mem. ASME, California Institute of Technology, Pasadena, Calif. 1947 ASME Annual Meeting paper No. **47-A-112** (mimeographed).

This paper describes the Hydrodynamics Laboratory and its principal pieces of equipment, and outlines the scope of investigations which it is equipped to undertake.

During the war the Laboratory was operated under contract with the Office of Scientific Research and Development and later for the U. S. Navy Bureau of Ordnance. Among the problems investigated have been the force systems acting on a moving submerged body, mechanism of cavitation, the effect of shape on cavitation, and many others having wide nonmilitary application.



CONTROLLED ATMOSPHERE LAUNCHING TANK BEING LOWERED INTO THE BASEMENT OF THE CIT HYDRODYNAMICS LABORATORY

The Laboratory has an available floor space of 15,000 sq ft and five major pieces of research equipment. These are: a high-speed water tunnel, free-surface water tunnel, controlled-atmosphere launching tank, a polarized-light flume, and a ripple tank.

The paper describes in detail each piece of equipment along with major auxiliaries and tells how each is used in a typical research project. Forty-two photographs and drawings illustrate the paper.

Applied Mechanics

The Absolute Calibration of Electro-Mechanical Pickups, by H. M. Trent, Naval Research Laboratory, Navy Department, Washington, D. C. 1947 ASME Annual Meeting paper No. **47-A-5**(in type).

A new method of calibrating electromechanical pickups is presented in this paper. Given two linear indicators, one of which is bilateral, it is shown that the sensitivities of the units can be established in both magnitude and phase by three experiments which do not involve the direct measurement of oscillating mechanical quantities. It is shown, also, that the technique does not depend upon the specific designs of the units.

A report will be made later concerning the actual development of a set of primary standards and their absolute calibration by reciprocity methods.

A Numerical Solution for the Torsion of Hollow Sections, by E. C. Colin, Jr., and N. M. Newmark, Department of Civil Engineering, University of Illinois, Urbana, Ill. 1947 ASME Annual Meeting paper No. **47-A-7** (in type).

A numerical method for solving directly the problem of the torsion of a bar of constant cross section having one or more internal longitudinal holes is described. The method involves the use of finite differences and can be used with either the iteration procedure due to Liebmann, or the relaxation procedure attributed to Southwell. The method avoids the necessity of combining a number of separate solutions since it establishes the necessary conditions around the hole by a special condition which amounts, in general, to treating the entire hole as a single point in a network, and determining the elevation of this point (i.e., the elevation of the stress function for torsion at the boundary of the hole) by a relation similar in form to that used for regular points of the network. The calculations by this method appear to converge at least as rapidly as for a section without a hole.

Critical Shear Stress of Plates Above the Proportional Limit, by George Gerard, Guggenheim School of Aeronautics, New York University, New York, N. Y. 1947 ASME Annual Meeting paper No. **47-A-11** (in type).

The secant-modulus method previously used for determining critical compressive stresses above the proportional limit has been extended for use in determining critical shear stresses above the proportional limit. The method was confirmed by an experimental program designed to check the use of the shear-secant modulus in the critical-shear-stress-equation. Nondimensional critical-shear-stress design curves are presented for use with aluminum alloys. The test procedure, determination of instability data, test results, etc., are given.

Effect of Bending Rigidity of Stringers Upon Stress Distribution in Reinforced Monocoque Cylinder Under Concentrated Transverse Loads, by Robert S. Levy, Project Stress Analyst, Republic Aviation Corporation, Farmingdale, L.I., N.Y. 1947 ASME Annual Meeting paper No. **47-A-12** (in type).

Least-work analysis of stress distribution in a reinforced circular monocoque cylinder is extended to determine the effect of bending resistant stringers located at the points of application of concentrated transverse loads. Calculations for a numerical example, with applied loads diametrically opposed, indicate that neglect of stringer bending rigidity results in calculated maximum shear stresses approximately 20 per cent conservative in the fields of load application and 50 per cent unsafe in an intermediate field. Further calculations indicate that the bending rigidity of the stringer has less effect when all loads are applied at the same circumferential location. Comparison of shear stresses, calculated by the present method with strain-rosette readings, indicate good agreement.

Effect of a Concentric Reinforcing Ring on Stiffness and Strength of a Circular Plate, by W. A. Nash, University Fellow, University of Michigan, Ann Arbor, Mich., 1947 ASME Annual Meeting paper No. **47-A-15** (in type).

In this study of a fixed-edge circular plate subjected to uniform normal pressure (such as is commonly used on ends of thin-walled cylindrical pressure vessels), it is shown that the maximum vertical deflection, the maximum radial stress, and the maximum tangential stress may all be reduced by reinforcing the plate with a concentric ring.

The bending of a circular plate loaded symmetrically with respect to the center; the twisting of a circular ring by couples uniformly distributed along its center line; bending of a fixed-edge circular plate reinforced by a concentric ring; effect of a ring on deflections; principal stresses in a reinforced plate; the effect of a ring on radial stress; and the effect of a ring on tangential stress are discussed.

Machine Design

Development of a High-Speed Lathe for Machining Aluminums, by R. L. Templin, Mem. ASME, Aluminum Company of America, New Kensington, Pa. 1947 ASME Annual Meeting paper No. **47-A-41** (mimeographed).

This paper describes an experimental turret-type high-speed lathe, for machining aluminum, having a maximum spindle speed of 9000 rpm capable of taking a $2^{1}/_{4}$-in-diam bar through its hollow spindle, driven by a special 80-hp motor, together with certain accessory equipment. It describes in detail certain machining experiments conducted with the lathe on two aluminum alloys at cutting speeds varying from 5000 to 20,000 fpm. Various conditions of machining were used resulting in different amounts of metal being removed with a single-point lathe tool up to a maximum of 470 cu in. per min. Data are given for the horsepower required for the various conditions investigated and the results are presented in chart form.

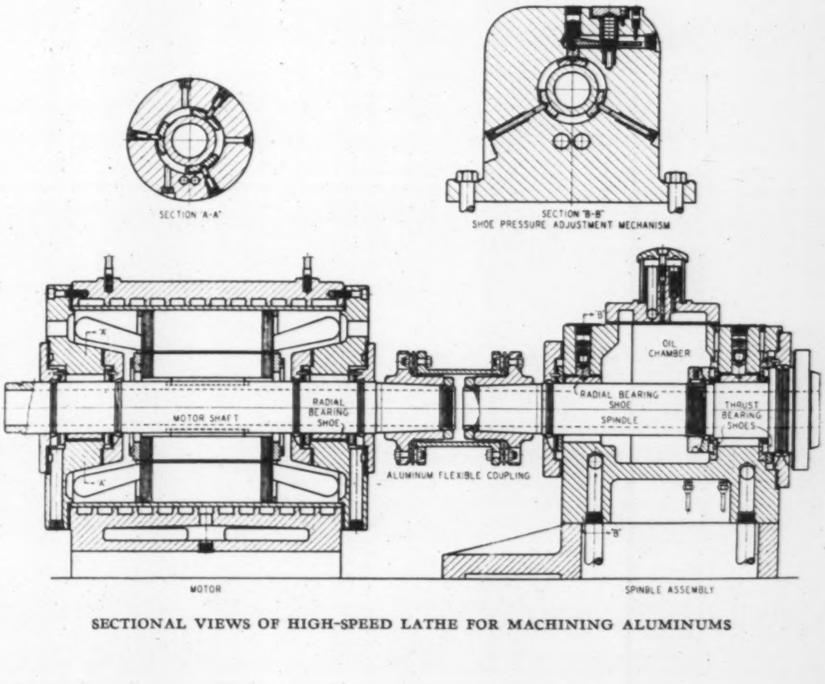
The ability of this machine to remove metal at such fast rates focuses attention on the problems generally associated with chip disposal. The relatively large kinetic energy imparted to the chips by the high cutting speeds can be utilized in their disposal. When the chips are short and broken, suitable shields or guards can and should be used to deflect the chips into suitable receivers or conveyers. When the cuttings are long and continuous, the tools can be designed to direct them away from the work and into a pile or container some convenient distance from the lathe.

Some conclusions have been reached concerning the relationships obtained between efficient metal removal, feeds, speeds, finish, and dimensional control. For instance: (1) Aluminum alloys can be satisfactorily machined by turning at cutting speeds up to 20,000 fpm; (2) the number of cubic inches of metal which can be removed per minute for each horsepower going into the cut is greater for as-rolled 14S than for 14S-T or 24S-T and increases with increasing rate of tool feed; (3) the net horsepower required to remove a given volume of metal is independent of cutting speed and depth of cut; (4) as much as 470 cu in. of metal per min (approximately 47 lb) were removed without overtaxing the equipment; (5) satisfactory machined surface quality can be maintained only if the tools are designed to direct the chips away from the work and prevent them from marring the finished surface; (6) even though the cuts were performed without a cutting compound, the work remained cool and the heat was carried away by the chips; and (7) the maximum condition of unbalance which is permissible in turning with this lathe is that which would produce a centrifugal force of about 700 lb.

An Analysis of the Dynamic Forces in a Cam-Driven System, by John A. Hrones, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1947 ASME Annual Meeting paper No. **47-A-46** (in type).

The influence of the mass, elasticity, and damping of a cam-driven system upon the magnitude and character of the forces imposed upon the cam are analyzed and discussed from a general viewpoint. Actual solutions for the force-displacement characteristics of three widely used cam contours, gravity cam, harmonic cam, and cycloidal cam, are carried out.

Discussed specifically are the properties of the combined follower-output member system; forces on the cam follower; and determination of cam forces for specific cam contour.



SECTIONAL VIEWS OF HIGH-SPEED LATHE FOR MACHINING ALUMINUMS

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Properties of Beryllium Copper

Comment by G. F. Nordenholt[1]

The author of this paper[2] has strikingly demonstrated the truism that the cost per pound of the material bears little relation to cost of the finished product incorporating that material. Frequently, the high-priced material costs considerably less. By the exercise of a great deal of thought and ingenuity in order to take maximum advantages of the outstanding properties of a specific material, the designer finds that he has saved considerably in the manufacturing cost of the finished product by the use of a more expensive material.

Not all of the savings are tangible. A 33-lb aluminum casting which replaces a 106-lb gray-iron casting will save a great deal more money than the obvious savings through faster machining, less expensive cleaning operations, and fewer finishing coats. In this instance, one of the intangible savings is the lower cost of handling the castings and transporting them through the shop by virtue of their lighter weight.

Similarly, the author has shown by example that the precision stampings of beryllium copper eliminated selective assembly and substituted interchangeable assembly. The tangible saving in interchangeable assembly results directly from the speedier assembly operations.

However, there is another saving which may be far greater. It is the saving represented by the fewer pieces that are required. It is merely necessary to make the number of pieces required to meet the order, where, as in selective assembly, it may be necessary to make twice as many pieces, the excess pieces going back into stores to be held in stock for the next order. The intangible cost of handling these pieces, storing them, and keeping all of the stock records involved, is often a major item.

Comment by Walter C. Troy[3]

It is believed that some degree of attention should be directed to those features of spring "fixture heat-treatment" which have sometimes militated against its use in conventional ferrous spring materials. These same features also pertain to the use of this technique in the manufacture of beryllium-copper springs.

As a consequence of fixture heat-treatment, the finished spring can be regarded as being in an essentially stress-free condition. This fact precludes the utilization of favorable residual internal-stress patterns which are sometimes intentionally introduced to enhance the performance of a spring. For example, the final forming operations on a flat spring can be so arranged as to leave a high value of orderly residual compressive stresses in those fibers which are subjected to tensile stresses as a consequence of the applied service load. By this method it is possible to produce a spring capable of supporting a load more than 30 per cent higher than the load which the spring could support if it were in a completely stress-free condition. As development of these favorable residual compressive-stress patterns requires certain controlled mechanical deformations after heat-treatment of the material, the use of fixture heat-treatment obviously precludes achieving the advantages associated with these favorable residual internal stresses.

Helical extension springs are frequently coiled to carry a substantial value of accurately controlled initial tension. In many cases the use of the initial tension feature of a helical extension spring allows a considerable saving of space, since it is not necessary to extend the spring in order to build up load. One of the essential inherent characteristics of a fixture-heat-treated helical spring is that it is practically stress-free; therefore the spring cannot be produced to carry any value of initial tension.

In the manufacture of flat springs, a final "setting" operation is sometimes used to achieve improved uniformity of load for a given deflection. For example, a constant-moment flat spring, supported at the ends and loaded at the center, may receive a final operation which consists in deflecting it beyond its yield strength and allowing it to spring back to its free final shape. This operation establishes a high degree of uniformity in the final product, and even corrects for thickness variations within the normal thickness tolerance. Since a thick spring will develop a higher maximum fiber stress during such a setting operation, it will take a greater set and therefore end up with a lower camber. In this manner the operation corrects for thickness variations.

When fixture heat-treatment is employed in the manufacture of a flat spring of the type just described, all springs are produced to the same shape regardless of thickness variations within the specified tolerance. In some cases the deflection variations encountered as a result of thickness variations are significant. For example, the deflection of a uniform-section spring, loaded at the mid-point, and supported at the ends, is given by

$$\frac{Pl^3}{48EI}$$

From this relationship, it may be seen that the deflection will vary inversely with the value of the moment of inertia, I. In the case of a thin spring, say, 0.010 in. thick, the variation in deflection caused by a thickness difference of 0.001 in. will be in the ratio of $\frac{0.010^3}{0.011^3}$ since the moment of inertia varies as the cube of the thickness. Thus deflection variation would be in the order of 30 per cent. Therefore the optimum manufacturing operation would be one which would produce a higher camber for the thin springs than for the thick ones, if it is desired for the spring to deflect to a given position for a given load. Fixture heat-treatment which produces the same shape in all springs whether on the high side or low side of the thickness tolerance, precludes the possibility of manufacturing as just described.

It is desired to register the observation that heat-treat forming, as applied to beryllium-copper springs, is a real contribution to spring-manufacturing technology, even though it is not the solution to all spring problems. It should continue to play a prominent role in the manufacture of those components which require unusually close control of shape and dimensions.

---

[1] Editor, ***Product Engineering***, New York, N. Y. Mem. ASME.

[2] "Stress-Relief-Hardening of Beryllium Copper," by R. W. Carson, Mechanical Engineering, vol. 69, August, 1947, pp. 651–654.

[3] Metals Division, Armour Research Foundation of the Illinois Institute of Technology, Chicago, Ill.

AUTHOR'S CLOSURE

Mr. Troy's comments regarding internal stresses in springs apply rather generally to all spring materials except beryllium copper. As pointed out in the paper, temperatures required for hardening of beryllium copper are in the range where complete or nearly complete stress relief occurs. It is impossible therefore to retain in hardened beryllium copper any significant amount of internal stress for such desirable purposes as improving endurance strength or introducing initial tension.

Some residual stress does remain in beryllium copper when it is hardened at temperatures in the range of 550 to 600 F, but it is too small to be of any of the benefits Mr. Troy mentions, and yet it is enough to prevent full conformity to a heat-treating fixture. At hardening temperatures in the range of 700 F, however, stress relief is so nearly complete that good fixture conformity is obtained.

The setting operation suggested by Mr. Troy would be effective in eliminating variations only if the yield strength were the same in all parts; or in other words, if springback in forming the parts were constant. But variable springback is a common problem met in fabricating stampings from any spring temper stock. Further, for usual forms of flat springs such as described in the paper, yielding in setting would take place in a section subjected to cold work in forming which would of course introduce still further variation in yield strength.

From practical manufacturing considerations, springback is a much more serious source of variation than stock thickness in producing the forms usually required in small stampings. With beryllium copper, fixture hardening does eliminate springback as a variable and thus provides a significant improvement in uniformity. Stock thickness variations remain as an undesirable factor in many flat-spring applications, but this is perhaps more readily corrected in rolling the material.

Mr. Nordenholt's comments show he has clearly caught the idea behind this paper: That the assembled cost of a part is often of more significance than the piece cost alone. With beryllium copper, and some of the other new spring alloys, maximum cost savings require critical examination of many traditional practices.

R. W. CARSON.[4]

---

[4] Consulting Engineer, Little Falls, N. J.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Wind-Tunnel Testing

WIND-TUNNEL TESTING. By Alan Pope. John Wiley & Sons, Inc., New York, N. Y., 1947. Cloth, $5^1/_2 \times 8^3/_8$ in., 319 pp., illus., $5.

REVIEWED BY HUGH L. DRYDEN[1]

ONE of the most important tools used by aeronautical engineers in the development of modern aircraft is the wind tunnel, a specially designed piece of equipment for producing a uniform and steady current of air through a "test section." Models of aircraft or parts of aircraft may be placed in the test section and systematic studies made of the reactions of the moving air on them. Since the action of the air is dependent only on the relative motion, the results apply to similar objects traveling through the air, although due allowance must be made for the effects of the limited dimensions of the air stream, of the model supports, of the size of the model, and of the turbulence of the air stream not present in the free atmosphere.

In addition to the direct use of wind tunnels for testing specific models of aircraft, experiments conducted in them have established on a firm foundation the science of aerodynamics which forms the basis of rational methods of aircraft design.

Notwithstanding the great importance of wind tunnels and wind-tunnel methods, there have been few books written on the subject. A great deal of the available experience is unpublished, and the published information is scattered in a wide variety of journals. The reviewer does not know of any treatment of this subject since that of A. Toussaint and E. N. Jacobs in Division I of Durand's "Aerodynamic Theory" in 1935. In the intervening years there have been many developments, and wind-tunnel testing has assumed increased importance. Many very large high-speed wind tunnels have come into use and many papers relating to wind-tunnel testing have been published. Professor Pope's book is therefore quite timely.

The book includes nine chapters devoted respectively to: A general description of types of wind tunnels and a tabulation of the characteristics of over 100 wind tunnels; a discussion of the design of wind tunnels; calibration of wind tunnels; methods of measurement of forces, moments, and pressures; details of the testing procedure; corrections for the influence of the wind-tunnel boundaries; extrapolation of wind-tunnel results to full scale; auxiliary testing equipment; and a final short chapter on small wind tunnels.

The author has addressed his book to the needs of students in college wind-tunnel laboratories, wind-tunnel engineers, and designers of small low-cost wind tunnels. There are 18 problems and eight experiments described for the

---

[1] Director of Aeronautical Research, National Advisory Committee for Aeronautics, Washington, D. C., Mem. ASME.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

student. While high-speed wind tunnels, very large wind tunnels, and special-purpose wind tunnels are also described, the major content of the book reflects the experience of the author with a wind tunnel about 10 ft in diameter and of speed of 200 to 300 miles per hour. Methods, models, and tests applying to this size are described in detail and with assurance. The discussion of high-speed wind tunnels is quite inadequate. Moreover, many aeronautical engineers will find the treatment of scale effect and extrapolation to full scale at variance with their own ideas.

Notwithstanding these limitations, the author has accomplished in a creditable manner his goal of writing an integrated account of wind-tunnel testing for students and for the staff of university and industry wind tunnels. In view of the absence of books in this field, many others will find the book useful.

Books Received in Library

ASTM STANDARDS ON COAL AND COKE (with Related Information) prepared by ASTM Committee D-5 on Coal and Coke. American Society for Testing Materials, Philadelphia, Pa., August, 1947. Paper, 6 × 9 in., 159 pp., illus., diagrams, charts, tables, $2. This publication brings together in convenient form the various ASTM methods of testing, definitions, and specifications for coal and coke, as well as the standard specifications for the classification of coal according to rank and grade. Eight proposed test methods are included as appendexes, for information and comment.

CALLAWAY TEXTILE DICTIONARY. By W. L. Carmichael, G. E. Linton, and I. Price. Callaway Mills, La Grange, Ga., 1947. Cloth, $5^1/_4 \times 8$ in., 392 pp., illus., $4. Designed for use by those in the textile and related industries and professions, this volume comprehensively covers the terminology of textile manufacturing and its products. It includes those products contained within the categories of yarns and woven fabrics, including the dyeing and finishing processes, the major synthetic and natural fibers used, and the steps involved in the production of the completed article.

CHEROKEE PROJECT, Technical Report No. 7. United States Tennessee Valley Authority, Knoxville, Tenn., 1946. Cloth, $5^3/_4 \times 9^1/_4$ in., 411 pp., illus., diagrams, charts, maps, tables, $1.50. Prepared by the engineering and construction staff of the TVA, this report covers the planning, design, construction, and initial operations of the Cherokee Dam and Reservoir. The volume describes in detail this main tributary project, the first of several TVA dams authorized under the World War II Emergency Program and constructed on an emergency basis; 138 pictures and graphs, plus some thirty tables, illustrate and amplify the text material.

EXPOSITION, Technical and Popular, edited by J. R. Gould and S. P. Olmsted. Longmans, Green and Co., New York, N. Y., London, England, Toronto, Canada, 1947. Cloth, $5^1/_2 \times 8^1/_4$ in., 126 pp., diagrams, tables, $1.75. Using the term "exposition" to mean the type of writing of which the basic function is to inform, this book describes writing techniques for the man with a technical background as well as for the general reader. The material is presented in three sections. The first of these sections analyzes the various types of exposition and includes models extending from the simple to the complex, and from the technical to the popular. The research article is handled in section two. Attention is directed to methods of research, systems of note taking, and the preparation of footnotes and bibliography. The third section shows the devices which may be used in the adaptation of specialized material for the lay audience.

INDUSTRIAL MANAGEMENT. By W. R. Spriegel and R. H. Lansburgh. Fourth edition. John Wiley & Sons, Inc., New York, N. Y., Chapman & Hall, London, England, 1947. Cloth, $5^3/_4 \times 9^1/_4$ in., 656 pp., illus., diagrams, charts, tables, $5. Policies and principles of successful management are presented, with the devices necessary for carrying them out, keeping in mind the needs both of the college student and the executive. Throughout the book an effort has been made to show the interdependence of the various major departments of a business. This fourth edition has been thoroughly revised to cover the recent developments in the field, and includes as new material a chapter on maintenance. There is a broadly classified bibliography.

INSTRUMENTATION AND CONTROL IN THE GERMAN CHEMICAL INDUSTRY. PB 75861. By C. H. Gregory, H. B. Appleton, A. P. Lowes and F. C. Whalen. Mapleton House, Brooklyn, N. Y., 1947. Paper, $5^1/_4 \times 8$ in., 157 pp., illus., diagrams, charts, tables, $6. Derived from an investigation by the British Intelligence Objectives Subcommittee, this volume reports the application of industrial instruments in the German chemical industry. The designs and manufacture of standard and special instruments are described, including recent research and development. Instruments used to measure flow, pressure, temperature, and density are discussed as well as instruments used for analysis, measurement, and automatic control.

LIGHT METALS IN STRUCTURAL ENGINEERING. By L. Dudley. Published for Temple Press, Ltd., by The English Universities Press Ltd., London, E. C. 4, England, 1947. Cloth, $5^1/_2 \times 8^3/_4$ in., 216 pp., diagrams, charts, tables, 30 s. The important principles of the subject of "strength of materials" are covered, with emphasis on the application of these principles to problems involving the use of aluminum, aluminum alloys, and magnesium alloys. The book covers much of the information required for the examinations in strength of materials set by the various British professional-engineering institutions. Calculus has been used in the explanation of theory, but an understanding of this branch of mathematics is not essential for the majority of the problems and worked examples.

LUMBER, Manufacture, Conditioning, Grading, Distribution and Use. By N. C. Brown. John Wiley & Sons, Inc., New York, N. Y., Chapman & Hall, London, England, 1947. Cloth, $5^1/_2 \times 8^1/_2$ in., 344 pp., illus., diagrams, maps, tables, $4.25. Of interest to those concerned with wood utilization and intended as a textbook for use in professional forestry schools, this volume covers most of the phases of the industry with the exception of logging. The general manufacturing procedures for converting logs into lumber are analyzed, and equipment, sawing methods, power requirements, and the utilization of by-products are discussed. Conditioning, by air seasoning and by kiln drying, is explained and the grading process is examined. The distribution of lumber through the manufacturer, retailer, and wholesaler and the utilization of the distributed product are dealt with. Constant emphasis is placed on the necessity for efficient and economical methods in all stages of production.

MATERIALS OF INDUSTRY, Their Distribution and Production. By S. F. Mersereau. Fourth edition, revised by C. G. Reen and K. L. Holderman. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1947. Cloth, $5^1/_2 \times 8^1/_4$ in., 623 pp., illus., diagrams, maps, tables, $2.80. Filling the need of the high school and the technical school for a more systematic study of the common materials of industry, this volume aims to give the student a logical working knowledge of these materials and the industrial processes by which they are produced. Emphasis is placed on raw materials, their distribution and production, as well as their general properties, transportation, conversion into commercial forms, and their economic importance. New material on plywood, fiberboard, wallboards, alloy steels, glass, magnesium, synthetic rubber, and plastics has been added in this fourth edition.

MEN AND VOLTS AT WAR, the Story of General Electric in World War II. By J. A. Miller. McGraw-Hill Book Co., Inc., Whittlesey House Division, New York, N. Y., and London, England, 1947. Cloth, $6 \times 9^1/_4$ in., 272 pp., illus., tables, $3.75. This is the story of the General Electric Company's accomplishments in World War II. It is divided into two sections. The first part deals with the company's activities in the making of combat equipment for use on land, on the sea, and in the air. Products for industry are considered in part two. The part that General Electric played in the Manhattan District project of atomic research is treated.

METALS AND PLASTICS, Production and Processing. By T. P. Hughes. Irwin-Farnham Publishing Co., Chicago, Ill., 1947. Cloth, $6 \times 9^1/_4$ in., 373 pp., illus., diagrams, charts, tables, $4.50. The underlying purpose of this volume is to present a comprehensive survey of manufacturing processes with a detailed study of some of the more common metals, alloys, and plastics so that an understanding of their fundamental potentialities and a basis for selection may be obtained. A knowledge of basic science in chemistry and physics is assumed. Glossaries of terms used in the text are in the Appendix. Classifications are provided for the plastics materials and, in the final chapter, for steels according to the AISI and SAE systems.

ON UNDERSTANDING SCIENCE, an Historical Approach. By J. B. Conant. Yale University Press, New Haven, Conn.; Geoffrey Cumberlege, Oxford University Press, London, England, 1947. Cloth, $5^1/_4 \times 8^1/_4$ in., 145 pp., illus., diagrams, tables, $2. The purpose of this volume is to provide the layman with an effective method for finding out what science is and how to understand it. A historical view is given of a number of great scientists, of the knowledge available in each one's generation, of the problems they set out to examine, and of how these problems were solved. The reader follows the scientific method at work, with all its limitations and wonders.

PREPARATION AND USE OF VISUAL AIDS

By K. B. Haas and H. Q. Packer. Prentice-Hall, Inc., New York, N. Y., 1947. Cloth, 6 × $9^{1}/_{4}$ in., 224 pp., illus., diagrams, charts, maps, tables, $4. Designed as a basic or supplementary textbook, this volume has been prepared for those who can use visual aids as an effective means of improving the presentation of any subject. Thirteen chapters present a brief discussion of visual aids and methods for their effective use. The book details how to use, how to prepare, and where to find these aids. Motion pictures, film slides and strips, pictures, and photographs are covered. Opaque projection, the use of maps, charts, graphs, diagrams, flash cards, posters, manuals, and television are also discussed in relation to their use.

Principles of Industrial Organization. By D. S. Kimball and D. S. Kimball, Jr. Sixth edition. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1947. Cloth, 6 × 9 in., 531 pp., illus., diagrams, charts, tables, $4.50. In use as a college text for more than thirty years, this volume provides a comprehensive treatment of the internal organization and procedures of industrial enterprises. This sixth edition omits obsolete material and rearranges much of the subject matter. New material on ownership, industrial legislation, unionism, inspection, job evaluation, and merit rating is considered. The usual topics, such as control of production, time and motion studies, purchasing, standards and standardization, principles of cost finding and industrial relations, are discussed.

Production With Safety. By A. L. Dickie. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1947. Cloth, 6 × $9^{1}/_{4}$ in., 242 pp., diagrams, tables, $2.50. Accident prevention is demonstrated as a plant investment which results in substantial dollar savings. The book shows how accidents to workers, machines, and materials can be controlled, and how such control will reduce costs and increase production efficiency. The responsibility of the industrial supervisor is clearly shown, and a description of a typical safety engineer on the job illustrates the requirements of the work. Thirteen safety talks are included for use as best suits any given plant situation.

Report on German Blast Furnace Practice and Plant. British Iron and Steel Federation and British Iron and Steel Research Association, London, 1946. Paper, $6^{1}/_{4}$ × $9^{1}/_{4}$ in., 57 pp., diagrams, charts, tables, 10s, 6d. Prepared under the auspices of a British Intelligence Subcommittee, this volume deals with the development of German blast-furnace practice and design during the war. Among the changes in processes and equipment, the progress made in the installation of plants for ore crushing and sintering is particularly noted. The changes in furnace design are discussed as well as the progress made in the development of blower equipment, gas-cleaning practice, and vortex dust catchers.

Rotary-Valve Engines. By M. C. I. Hunter. Hutchinson's Scientific and Technical Publications, London, England, New York, N. Y., Melbourne, Australia, Sydney, Australia, Cape Town, South Africa, 1946. Cloth, $5^{1}/_{4}$ × $8^{1}/_{2}$ in., 216 pp., illus., diagrams, charts, tables, 21 s. The author describes the general principles and applications of the rotary valve in detail and draws comparisons between it and the poppet valve for use on internal-combustion engines. The development of the rotary valve up to the present time is also discussed with descriptions of various rotary and semirotary systems applied to various types of old and modern engines—steam, gas, and gasoline. A brief final chapter presents the author's conjectures on the future development of the rotary valve.

Spring Design and Calculations, compiled by J. A. Roberts. Technical Research Laboratory, Herbert Terry and Sons, Limited, Redditch, England, 1947. Cloth, $4^{3}/_{4}$ × $7^{1}/_{2}$ in., 114 pp., illus., diagrams, charts, tables, 10 s, 6 d. This small book gives examples of practical design calculations for a variety of spring types. Belleville washers, retaining rings, and spring driving belts are also covered. Brief chapters are devoted to the power and natural frequency of springs, the surging of valve springs, and combined axial and horizontal loading on compression springs. Helpful hints are given for ordering springs.

Symposium on pH Measurement, 49th Annual Meeting, American Society for Testing Materials, Buffalo, N. Y., June 24–28, 1946. Technical Publication No. 73. American Society for Testing Materials, Philadelphia, Pa., 1947. Paper, 6 × 9 in., 79 pp., diagrams, charts, tables, $1.50; to ASTM members, $1.15. This compilation presents seven papers on the latest theory and practice in colorimetric and potentiometric methods for making pH and closely related measurements. The following topics are covered: historical review, the fundamentals and theoretical basis for pH determinations, recent advances in principal methods and techniques, and applications to particular fields.

Tables of the Bessel Functions $J_0(z)$ and $J_1(z)$ for Complex Arguments, prepared by the Mathematical Tables Project, National Bureau of Standards. Second edition. Columbia University Press, New York, N. Y., 1947. Cloth, $7^{3}/_{4}$ × $10^{3}/_{4}$ in., 403 pp., diagrams, $7.50. Presenting 10-place tables prepared by the mathematical-tables project of the National Bureau of Standards, this volume covers the functions of $J_0(z)$ and $J_0(z)$ for moduli ranging from 1 to 10 at intervals of 0.01. Contour lines of $J_0(z)$ and $J_1(z)$ are given, as well as a table of Lagrangian interpolation coefficients. A bibliography containing 67 references is also included.

Textbook of the Materials of Engineering. By H. F. Moore and others. Seventh edition. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1947. Cloth, 6 × $9^{1}/_{4}$ in., 500 pp., illus., diagrams, charts, tables, $5. Elementary in character, this book is devoted to the common materials used in structures and machines, together with brief descriptions of their manufacture and fabrication. Primary emphasis is placed on the strength, toughness, and stiffness of stress-carrying materials. The revised edition covers many new materials of construction, developed during the war, and new methods of processing them. Additional data on plastics, synthetic rubber, testing machines, and methods have been included. Reference material is given at the end of each chapter and a section of review questions is provided.

Technical Drawing Problems. By F. E. Giesecke, A. Mitchell, and H. C. Spencer. Second edition. The Macmillan Company, New York, N. Y., 1947. Paper, ring binder, $9^{1}/_{4}$ × 11 in., 9 pp. text, 105 sheets of diagrams, $2.75. Containing problems which are designed to cover the important fundamental principles of technical drawing, this volume is not intended for use as a complete course in itself. The problems are divided into units, and references are given under each unit to the section in "Technical Drawing," second edition, by the same authors. Following a section on the use of instruments is one on the geometry of technical drawing. Succeeding sections discuss the construction of letters and numbers, problems on views, identification, revolutions, isometric and oblique drawing, and dimensioning. Problems on fasteners and springs complete the book.

ASME BOILER CODE

Interpretations

The Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Anyone desiring information on the application of the Code may communicate with the Committee Secretary, ASME, 29 West 39th St., New York 18, N. Y.

The procedure of the Committee in handling the Cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are then sent by the Secretary of the Committee to all members of the Committee. The interpretation, in the form of a reply, is then prepared by the Committee and is passed upon at a regular meeting.

This interpretation is later submitted to the Council of The American Society of Mechanical Engineers for approval after which it is issued to the inquirer and published in Mechanical Engineering.

Following is a record of the interpretations of this Committee formulated at the meeting of November 21, 1947, and approved by the Council on December 29, 1947.

Case No. 828

(Annulled)

Case No. 896 (Reopened)

(Special Ruling)

Inquiry: Is it permissible under the rules of Section VIII of the Code, to construct fusion-welded pressure vessels of clad material complying with Specifications SA-263, SA-264, and SA-265?

Reply: It is the opinion of the Committee that fusion-welded pressure vessels may be constructed of clad plate material complying with the above specifications provided that all requirements in

Section VIII covering design, welding, and tests for the class of service for which the vessels are intended are complied with, as well as the following additional requirements:

(1) It is expected that vessels of the type covered by these rules will be used to hold liquids and gases corrosive to ordinary materials, but the selection of a material suitable for the vessel's contents and the determination of corrosion allowance is not covered by these rules.

It is recommended that users assure themselves by appropriate tests or otherwise, that the cladding material selected and its heat-treatment following fabrication are suitable for the service intended.

Where service data are not available, the procedure of Par. U-11(**b**) shall be followed.

(2) The base plate material shall be in accordance with a plate specification approved for welding.

(3) All clad steel plates shall show a minimum shear test of 20,000 psi when tested in the manner described in the specification. One shear test shall be made on each clad plate as rolled and results reported by the mill.

(4) The weld shall be completed before radiography, where radiography is required, except that when the thickness of the steel base plate only is used in the design calculations and joint is made by first removing a narrow strip of cladding, then welding the base plate, and subsequently inserting a strip of the corrosion-resistant material welded along all edges to complete the cladding, the weld in the base plate may be radiographed before the strip is added.

When a joint that is required to be radiographed is covered by weld deposit, the radiography shall be done after such deposit is completed.

(5) When it is intended to protect portions of the base metal, welds in the base metal, flange faces, or other vessel parts against corrosion by layering with weld deposit, the welding procedure and each operator shall be qualified as follows:

(*a*) *Procedure*. A weld deposit of the same composition as will be used in the vessel shall be layered on a base plate $^{3}/_{8}$ in. to $^{7}/_{8}$ in. thick which shall be within the composition limits of the specification for the backing material to be used in construction. The plate shall be approximately 6 in. wide × 8–12 in. long with position of the plate during deposition of the weld metal to be the same as that used in applying deposits in fabrication of the vessel. The weld metal shall be deposited by the technique to be used in construction to form a pad to within 0.5–1.0 in. of the edges of the plate. Following welding, the test plate shall be subjected to the same heat-treatment, if any be used, as will be required for the vessel. After heat-treatment, if any, the pad shall be machined smooth on the face leaving approximately $^{1}/_{8}$ in. thickness of the deposited metal and on the opposite side if necessary to produce reasonably parallel faces and the desired thickness. Two bend test specimens shall be cut longitudinally and bent with the weld metal surface in tension. They may be either free or guided-bend tests. The elongation requirements of Par. Q-109(**b**) of the Code shall be met for a gage length of $^{1}/_{2}$ in.

(*b*) *Operator*. Each welding operator engaged in layering deposits shall make a test plate as described in (*a*) for the positions to be qualified as required by Par. Q-204. From each plate two face-bend specimens like Fig. Q-14 of the Code shall be prepared having about $^{1}/_{8}$ in. of the deposited metal on the face. The requirements of Par. Q-209 shall be met when these specimens are tested as required by Par. Q-208. Stress relief is not required but is permitted if the operator's work is all to be stress-relieved.

When deposits of this type are qualified under (11)(*a*), qualification under this paragraph is not required.

(6) The types of joints and welding procedure used shall be such that steel weld metal shall not fuse into the corrosion-resistant layer and the depth of the corrosion-resistant bead shall be kept to a minimum.

(7) Fillet welds may be used under the provisions of Par. U-70, provided the deposited weld metal meets the requirements of (8) and (5).

(8) It is important that the completed welds where exposed to the contents of the vessel have a corrosion-resistant property substantially equal to that of the cladding material. Such welds in the cladding material shall preferably be made using filler rods that will deposit metal of substantially the same analysis as the material joined. However, weld metal of a dissimilar analysis may be used if, in the opinion of the fabricator, a physically better deposit can be obtained and the user and the inspector are satisfied that the corrosion resistance will be sufficient for the intended service.

(9) The allowable stress shall not exceed the values given in the Code for the grade of steel used for the base material.

(10) Vessels constructed of Specification SA-263, Grades B and D, composite material shall be limited to a service temperature of 800 F maximum.

In no case shall the service temperature for vessels constructed of composite materials exceed the limiting temperature given in Table U-2 or in Table U-3 for either the backing or the facing material used.

Stress relief shall be mandatory for vessels constructed of chromium steel clad material complying with Specification SA-263, except Grade O material.

Because of the danger of cracking when welding material complying with Specification SA-263 with straight chromium steel welding rods, radiographic examination of all main seam welds is mandatory for Pars. U-69 and U-201 vessels, as well as for Pars. U-68 and U-200 vessels, and the completed alloy welds for Par. U-70 vessels shall be carefully examined for cracks. When austenitic welding rods are used on chromium-clad material, radiography of the welds is not required for Par. U-69 vessels, but the spot radiographic examination of Par. U-201 vessels is required.

(11)(*a*) When a joint is to be made by a procedure requiring that corrosion-resistant weld metal be laid upon base weld metal, the welding procedure qualification and vessel test plates shall be made from clad material of the same grade as used in the vessel, and operator qualifications shall be made on clad material of the same "O" numbers given in Table Q-5 for the base metal, and of the same "P" numbers, given in Table Q-5 for cladding and weld rod as used in the vessel. All of these tests shall include duplicate bend specimens, one of which shall be bent with the clad surface in tension and the other with the clad surface in compression and all shall meet the requirements of Section IX of the Code for the class of construction (Pars. U-68, U-69, or U-70) involved. When the cladding material is not listed in Table Q-5, both qualifications shall be made on material of the same grade as used in the vessel.

(*b*) When a joint is made by any other procedure than (*a*), the qualification tests may be made as in (*a*) or the welding procedure and operator qualifications may be made separately on the base metal to meet the requirements of Section IX, and on the cladding materials to meet the requirements of (5).

The all-weld metal tension specimen required by Par. U-68(**d**) shall contain no cladding on the gage length. When not enough base weld metal is available for the standard 0.505 specimen, it may be omitted.

(12)(*a*) For Pars. U-68, U-69, and U-70 vessels, the full thickness of the composite plate made to Specifications SA-263, SA-264, and SA-265 may be used in design calculations for all classes of construction when corrosion is not expected, provided the joints are made by depositing corrosion-resistant weld metal on the base metal weld to restore the cladding.

(*b*) For Pars. U-200 and U-201 vessels and for other Code vessels when corrosion is expected, or when for any reason it is preferred not to include the cladding as a strength element, the design shall be based upon the total thickness of the plate less the nominal minimum thickness of cladding specified. Reasonable excess thickness either of the actual cladding or corrosion-resistant weld metal may be considered to be an equal thickness of base material in applying Code rules. Inserted strips, if used to restore cladding at joints, shall be of a thickness equal to that of the nominal minimum thickness of cladding specified for the plates, backed, if necessary, with corrosion-resistant weld metal deposited in the groove to bring the insert flush with the surface of the adjacent cladding.

(13) When corrosion of the cladding material is expected, additional cladding metal thickness shall be provided. In such cases the thickness added for corrosion shall be removed from the clad face of all tension specimens before testing.

CASE NO. 1062

(Interpretation of Tables P-7 and U-2)

Inquiry: Maximum allowable working stresses for Specification SA-240, Grade M, have been increased in Tables P-7 and U-2 at temperatures of 1150 F and 1200 F. What allowable stresses at these temperatures may be used for the similar grades of material conforming to Specifications SA-213 and SA-249?

Reply: It is the opinion of the Committee that material conforming to Specification SA-213 Grade T20, and Specification SA-249 Grades T20 and T24, may be used at the same maximum allowable stresses as material conforming to Specification SA-240 Grade M, which are 5300 psi at 1150 F and 4000 psi at 1200 F.

Proposed Revisions and Addenda to Boiler Construction Code

IT IS the policy of the Boiler Code Committee to receive and consider as promptly as possible any desired revisions of the rules and its codes. Any suggestions for revisions or modifications that are approved by the Committee will be recommended for addenda to the code, to be included later in the proper place.

The following proposed revisions have been approved for publication as proposed addenda to the Code. They are published herewith with corresponding paragraph number to identify their location in the various sections of the code and are submitted for criticism and approval from anyone interested therein.

It is to be noted that a proposed revision of the code should not be considered final until formally adopted by the Council of the Society and issued as pink-colored addenda sheets. Added words are printed in SMALL CAPITALS; words to be deleted are enclosed in brackets [ ].

Communications should be addressed to the Secretary of the Boiler Code Committee, 29 West 39th St., New York 18, N. Y., in order that they may be presented to the Committee for consideration.

FORM Q-1. Revise title to read:

Recommended Form Q-1(A) for Manufacturers' Record of Qualification Test of Welding Procedures and Operators FOR GROOVE WELDS ON PLATE OR PIPE.

Add the following footnote to this form:

(Details of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

FORM Q-1(B). Add the following as Form Q-1(B).

RECOMMENDED FORM Q-1(B) FOR MANUFACTURER'S RECORD OF QUALIFICATION TEST OF WELDING PROCEDURES AND WELDING OPERATORS FOR FILLET WELDS ON PLATE OR PIPE

Record of..
(Process or Operator)

Manufacturer...Address.......................................

Welding Operator: Name.......................................Designating No...........Signature.......................

Material: Kind.......................................Specification.......................................T.S.......................
(Plate or Pipe)

Size of Weld.................in. Single or Multiple Pass.....................Welding Position.....................Stress Relieved.....................
(See sketches on reverse side) (Yes or No)

Welding Done in Accordance with Manufacturer's Welding Specification No.......................................Dated.......................

LONGITUDINAL OR TRANSVERSE SHEAR TEST WELD

(Indicate which test was made by striking out term that does not apply)

Specimen No.	Average throat dimension of welds, in. F	Ultimate total load, lb. P	Sum of lengths of welds that ruptured, in. (1) L	Shearing strength lb. per lineal in. (2) S′	Shearing strength lb. per sq. in. (3) S

(1) Prior to making the test, numbers should be stamped on each specimen adjacent to each weld and a record of the length of each weld in inches should be entered in the table below. List in the column above the sum of original lengths of those welds which ruptured.

(2) $S' = \dfrac{\text{Ultimate total load, } P}{\text{Sum of lengths of welds which ruptured, } L}$ (3) $S = \dfrac{\text{Shearing strength, lb. per lineal inch, } S'}{\text{Average throat dimension of welds, in., } F}$

RECORD OF LENGTHS OF WELDS, INCHES

Specimen No.	Weld Number							
	1	2	3	4	5	6	7	8

FREE-BEND TEST

Specimen No.	Gage length		Difference	Per cent difference	Remarks
	Before bending	After bending			

FILLET WELD SOUNDNESS TEST

Specimen No.	Describe the location, nature, and size of any crack or tearing of the specimen

The undersigned manufacturer certifies that the statements made in this report are correct and that the test welds were prepared welded, and tested in accordance with the requirements of Par..........................of the...Code.
(A.S.M.E. Power Boiler, Unfired Pressure Vessel, etc.)

Date...

Signed...
(Manufacturer)

By...

(Details of Record of Tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

RECOMMENDED FORM Q-1(B) (*continued*)

Welding witnessed by Inspector..on..

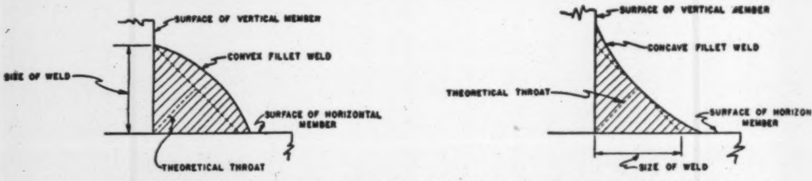
Testing witnessed by Inspector..on..

We have witnessed the welding and testing of the specimens referred to on this Record of Qualification Test and find the results as given hereon to be true. This statement does not constitute our approval of the process of welding or of the welding operator.

By..
Chief Inspector

Dated at...

On...


SURFACE OF VERTICAL MEMBER
CONVEX FILLET WELD
SIZE OF WELD
SURFACE OF HORIZONTAL MEMBER
THEORETICAL THROAT
SURFACE OF VERTICAL MEMBER
CONCAVE FILLET WELD
THEORETICAL THROAT
SURFACE OF HORIZONTAL MEMBER
SIZE OF WELD

NOTE: The "size" of a fillet weld is the leg length of the largest inscribed right isosceles triangle.

$$\text{Size} = \frac{\text{Throat}}{.707} \qquad \text{Throat} = .707 \times \text{Size}$$

PAR. P-102(**i**). Revise second section to read:

The manufacturer shall satisfy the inspector that all of the welding operators employed on a boiler drum or pressure part of a unit have previously made test plates which comply with the requirements of the Code. Such test plates shall have been made within a period of six months, except that when the welding operator is regularly employed on production work embracing the same process and type of welding, the test may be effective indefinitely.

PAR. P-112(**c**). Add the following:

Piping fabricated in accordance with this paragraph shall be subjected to a hydrostatic test of not less than $1^1/_2$ times the maximum allowable working pressure.

TABLE P-5. Add the following values for SA-213 Grade T22:

Tempera- tures.....	950	1000	1050	1100	1150	1200
Stresses.....	8250	6250	4800	3700	2700	1950

TABLES P-6 and U-3. Add the following Note:

NOTE: When nonferrous materials conforming to specifications given in Section II of the Code are used in welded or brazed construction, the maximum allowable working stresses shall not exceed the values given herein for annealed material at the metal temperature shown.

TABLES P-7 and U-2. For Specifications SA-213 Grade T20, and SA-249 Grades T20 and T24, revise stresses at 1150 and 1200 T to 5300 and 4000 psi respectively.

PAR. P-311(**a**). Revise last section to read·

All water walls and water screens which do not drain back into the boiler and all integral economizers shall be equipped with drain or blow-off valves conforming with the requirements of this paragraph and also of Pars. P-308 and P-309.

PAR. U-13(**c**). Revise items (1) and (2) to read:

(1) Vessels constructed of steel conforming to Specification SA-212 shall be subject to the stress-relieving requirement of Par. U-76(**b**).

(2) Vessels constructed of high tensile steels conforming to Specifications SA-202, SA-203, SA-204, and SA-225 shall be stress-relieved when the thickness is 0.58 in. and over.

TABLE U-3. Revise the values for the specifications given as follows:

Material and spec. number	Grade, type, or name	Condition	Spec. min. tens.	For metal temperatures not exceeding deg F Subzero to 150	250	300	350	400
ALUMINUM Plate, Sheet, or Strip								
SB-178	Aluminum	Annealed	11,000	2200**	1680	1440	1280	1120
SB-178	Aluminum	As-rolled*	13,000	2600**	2080	1920	1600	1200***
SB-178	Aluminum	$^1/_4$ Hard	14,000	2800	2240	2000	1680	1350***
SB-178	Aluminum	$^1/_2$ Hard	16,000	3200	2600	2350	2100	1700
ALUMINUM ALLOYS Plate, Sheet, or Strip								
SB-126	Alum. mang.	Annealed	14,000	2800	2400	2100	1800	1600
SB-126	Alum. mang.	As-rolled*	17,000	3400	3000	2700	2400	2200
SB-126	Alum. mang.	$^1/_4$ Hard	17,000	3400	3000	2700	2400	2200
SB-126	Alum. mang.	$^1/_2$ Hard	19,500	3900	3400	3150	2850	2500

* $^5/_8$ in. thick or less
** These values were originally 2240 and 2640
*** This value was originally 1200

PAR. U-68(**k**). Revise second section to read:

The manufacturer shall satisfy the inspector that all of the welding operators employed on a pressure vessel or pressure part of a unit have previously made test plates which comply with the requirements of the Code. Such test plates shall have been made within a period of six months, except that when the welding operator is regularly employed on production work embracing the same process and type of welding, the test may be effective indefinitely.

PAR. Q-110. Revise last sentence to read:

Recommended forms for recording the results of both procedure and operator qualification TESTS ARE [is] given as Forms Q-1(A) AND Q-1(B).

REVISIONS OF MATERIAL SPECIFICATIONS CODE OF ASME BOILER CONSTRUCTION CODE

The 1947 addenda to the Material Specifications Sections of the ASME Boiler Construction Code has been withheld until action could be taken to include the 1947 revisions of ASTM specifications affecting corresponding Code specifications. A review of the 1947 ASTM revisions has just been completed as a result of which the following specifications will be revised to make them identical with the latest ASTM specifications indicated: SA-30 (A 30-47), SA-47 (A 47-47), SA-106 (A106-47T), SA-129 (A 129-47), SA-197 (A 197-47), SA-201 (A 201-47), SA-202 (A 202-47), SA-203 (A 203-47T), SA-204 (A 204-47), SA-212 (A 212-47), SA-225 (A 225-47), SA-280 (A 280-47T), SA-285 (A 285-47), SB-11 (B 11-47), SB-12 (B 12-47), SB-42 (B 42-47), SB-43 (B 43-47), SB-75 (B 75-47T), SB-96 (B 96-47), SB-98 (B 98-47), SB-111 (B 111-47), SB-171 (B 171-47), SB-178 (B 178-47T). Specification SB-126 will be withdrawn inasmuch as the revision of Specification SB-178 includes the requirements covered by this specification. Any one interested in reviewing these revisions may obtain a copy upon application to the Secretary of the Boiler Code Committee in care of the Society.

ASME NEWS

And Notes on Other Engineering Societies

Compiled and Edited by A. F. Bochenek

BUSINESS DISTRICT OF NEW ORLEANS, LA., SCENE OF THE ASME 1948 SPRING MEETING

Tentative Program of the ASME 1948 Spring Meeting, March 1–4, New Orleans, La.

Headquarters: St. Charles Hotel

THE 1948 Spring Meeting of The American Society of Mechanical Engineers will be held at the St. Charles Hotel, New Orleans, La., March 1–4, 1948.

Among the Divisions sponsoring technical sessions are: Gas Turbine Power, Metals Engineering, Power, Management, Materials Handling, Heat Transfer, Fuels, and Process Industries.

In accordance with the traditional hospitality of the South, inspection trips and social events will play an important part in the success of this meeting. The first event on the program will be the Nuclear Energy Luncheon. On Monday evening, March 1, a reception will be held at the International House, an international club for citizens of the world who do business in New Orleans. Color films of New Orleans' world-famous Mardi Gras Carnival and Ball will be shown. On Tuesday, March 2, a general luncheon will be held at which the mayor of New Orleans will extend a welcome to members of the Society. The social program will be concluded with a banquet on Wednesday, March 3.

E. G. Bailey, President ASME, and vice-president, The Babcock and Wilcox Company, New York, N. Y., will be the main banquet speaker. His subject will be, "The Engineer and Internationalism."

Two interesting inspection trips have been planned: One to the semioutdoor generating station of the New Orleans Public Service, Inc., located on the Industrial Canal, and the other to the American Sugar Refinery located east of New Orleans on the Mississippi River. Other informal parties will be organized for tours to interesting sections of the city.

A fee of $5 will be charged nonmembers for admission to one or all of the technical sessions, except in the following cases: Authors of papers and nonmember student aides. Guest-attendance cards have been discontinued. Admission will be by registration badge only.

The Tentative Program

MONDAY, MARCH 1

9:00 a.m.

Registration

12:00 noon

Nuclear Energy Luncheon

(*Speaker:* To be announced)

2:00 p.m.

Gas Turbine Power

The Gas Turbine as Stationary Prime Mover, by L. N. Rowley, Jr., managing editor, and B. G. A. Skrotzki, assistant editor, *Power*, McGraw-Hill Publishing Company, Inc., New York, N. Y.

Gas Turbine Power Plants for Operation With Low-Cost Fuel, by John Goldsbury, mechanical engineer, General Electric Company, Lynn, Mass.

The Performance of Commercial Gas Turbines, by Paul R. Sidler, president, Brown, Boveri Corporation, New York, N. Y.

Survey: How New Gas Turbines Fit Into Tomorrow's Power Pattern, by S. A. Tucker, associate editor, *Electrical World*, McGraw-Hill Publishing Company, Inc., New York, N. Y.

Metals Engineering

Engineering the Tin-Plating Process, by Elmer T. Harris, Tennessee Coal, Iron, and Railroad Company, Birmingham, Ala.

Engineering the Tin Can, by H. S. Van Vleet, American Can Company, Maywood, Ill.

8:00 p.m.

Reception at International House

Program: Color film of Carnival and Ball will be shown.

TUESDAY, MARCH 2

9:00 a.m.

Power

Design and Operational Features of the Industrial Canal Steam-Electric Station, by A. H. Jensen, engineer, and J. F. Vogt, Jr., engineer, New Orleans Public Service, Inc., New Orleans, La.

Hotel Reservations

NINE New Orleans Hotels are cooperating to meet the needs of members during the 1948 Spring Meeting. In making reservations do not write directly to the hotels because under the arrangements made by the ASME Hotel Committee, such requests will not be honored.

Write or wire requests for reservations to Prof. J. Howell Peebles, Jr., Chairman, ASME Hotel Committee, College of Engineering, The Tulane University of Louisiana, New Orleans, La.

PIRATES' ALLEY IN THE HEART OF NEW ORLEANS FRENCH QUARTER

Carry-Over Improvement on a High-Pressure Boiler at Baytown Refinery, by H. B. Snider, power engineer, Humble Oil and Refining Company, Baytown, La.

Management

Papers to be announced.

12:00 noon

General Luncheon

Presiding Officer: James M. Robert, dean of engineering, The Tulane University of Louisiana, New Orleans, La.

Speaker: Honorable deLesseps S. Morrison, mayor of New Orleans.

Subject: Why Good Government is Related to Good Engineering and Good Business.

Progress Report of ASME in Region VIII, by Linn Helander, vice-president ASME, Region VIII, professor and head, department of mechanical engineering, Kansas State College, Manhattan, Kan.

1:30 p.m.

Inspection Trips

Industrial Canal Steam-Electric Generating Station of New Orleans Public Service, Inc., New Orleans, La.

Special trips to various places in and near New Orleans will be arranged for small groups or individuals upon request.

8:00 p.m.

Informal Ball

Tulane Room of the Jung Hotel

WEDNESDAY, MARCH 3

9:00 a.m.

Materials Handling

Papers to be announced

Heat Transfer

A Mathematical Analysis of a Number of Dielectric Heating Problems, by M. P. Heisler, department of mechanical engineering, Columbia University, New York, N. Y.

Heat Transfer Analysis of a Multicomponent Structure by Comparative Methods, by C. F. Kayan, associate professor, Columbia University, New York, N. Y.

2:00 p.m.

Inspection Trip

A guided tour will be conducted through the American Sugar Refining Company. Transportation to and from the refinery will be by chartered bus, necessitating a charge of 50 cents per member.

6:30 p.m.

Banquet

Toastmaster: James M. Todd, consulting engineer, New Orleans, La.

Speaker: E. G. Bailey, president ASME, and vice-president, The Babcock and Wilcox Company, N. Y. Subject: The Engineer and Internationalism.

THURSDAY, MARCH 4

9:00 a.m.

Fuels (I)—Process Industries (I)

Utilizing of Bagasse as Fuel, by F. X. Gilg, application engineer, Babcock and Wilcox Company, New York, N. Y.

Developments in Kraft-Process Recovery-Unit Design and Performance, by R. K. Allen, staff engineer, Babcock and Wilcox Company, New York, N. Y.

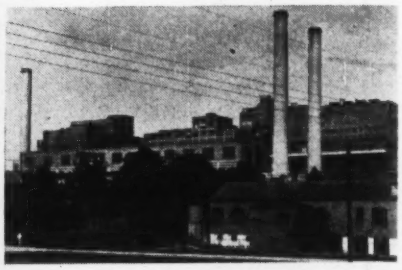
2:00 p.m.

Fuels (II)—Process Industries (II)

Conversion of the "Big Inch" and "Little Big Inch" Pipe Lines from Oil Service to Gas-Transmission, by B. D. Goodrich, chief engineer, Texas Eastern Transmission Corporation, Shreveport, La.

Accurate Wide-Range Metering of Natural Gas With the Differential-Type Meter, by L. K. Spink, engineer in charge of flow measurement, Foxboro Company, Neponset, Mass.

ANTOINE'S RESTAURANT, ONE OF THE FINE RESTAURANTS OF NEW ORLEANS WHICH FEATURES "LA CUISINE CREOLE"



THE AMERICAN SUGAR REFINERY PLANT TO WHICH AN INSPECTION TRIP IS PLANNED AS A FEATURE OF THE ASME 1948 SPRING MEETING

Gas-Turbine Parts Needed for Instruction Purposes

THE transition to peacetime education at Stanford University, Stanford, Calif., has included the establishment of a program of study in the field of gas turbines and jet propulsion. This is outgrowth of interest and encouragement on the part of the gas-turbine industry and the agencies of the Department of National Defense concerned with the improvement of this latest technological development. Work sponsored by these outside agencies will be undertaken as soon as the modernization of the university's laboratory to include this research can be effected.

A modest number of fellowships in the indicated applications of the basic sciences are being sought from industry and private donors.

Although a professionally competent teaching staff has been assembled, there is great need at present for representative gas-turbine parts that can be used as instruction models. Also, old or surplus jet-engine units that can be sectioned to show the flow of the working medium through the cycle are urgently needed.

Anyone having knowledge of the availability of such items is requested to communicate with Prof. V. C. Finch, member ASME, mechanical-engineering laboratory, Stanford University, Stanford, Calif.

Directory of Testing and Research Laboratories Available

A COMPLETE listing of commercial and university testing and research laboratories throughout the country, together with indications of the type of commodities tested, has been compiled by the National Bureau of Standards. This pamphlet is now available from the Government Printing office as NBS Miscellaneous Publication M187, "Directory of Commercial and College Laboratories."

Information is given concerning 220 commercial laboratories, with 80 branches or offices, and 189 college laboratories used for research and testing as well as instruction. Listings are arranged both geographically and alphabetically to facilitate the ready location of any laboratory. Miscellaneous Publication M187 may be obtained only from the Superintendent of Documents, Washington 25, D. C., at 30 cents per copy.

129 PIECES OF ANNUAL MEETING EQUIPMENT STORED IN THE HOTEL BASEMENT. SHOWN ARE 13 TRUNKS, 101 CARTONS, AND 15 CASES. TWENTY TYPEWRITERS ALSO USED ARE NOT SHOWN

What It Takes to Organize an ASME Annual Meeting

EACH year when thousands of members and guests attending an ASME Annual Meeting open the program booklet (the 1947 issue contained 107 pages) they may or may not be astonished at the professional vitality of a Society which can concentrate so much of interest to the mechanical engineer into a period of five days.

In the life of the ASME the program booklet is both the fruit and the seed of the Society's work. The 1947 booklet listed 74 technical sessions at which 294 authors presented 205 papers. Behind these statistics stands a host of committees, authors, and staff members who planned and worked out for the record, the year's harvest of engineering ideas and accumulated experiences in new methods and machines. While most members used the booklet to appraise what had been accomplished, an important nucleus of the Society leafed through the pages to find the time and place of committee meetings at which the Society's work for the coming year was to be outlined.

The booklet is actually a carefully worked out timetable which many times a day directs a complete distribution of three or four thousand people among many meeting rooms and dining halls.

Good Teamwork Required

Like some quarterback, it gives the signal which sets a gigantic team in action. On its cue, chairman, recorders, and authors assemble to be briefed on the conduct of technical sessions; staff members prepare the meeting rooms, and student aides take their posts. Preprints are located in the mass of 15 tons of equipment and printed matter assembled for the meeting. Innumerable projection lanterns, balopticans, screens, blackboards, silent and sound motion-picture machines are set up in any of 45 different rooms. Society banners are draped and guide cards posted to direct members through a maze of corridors to the sessions they seek. Before the session commences, each stage is set with equipment requested by the author; blackboards for those who speak with chalk in hand, projection lanterns for authors with slides, and the right silent or sound motion-picture machine for the right author. Such are the carefully timed kaleidoscopic mechanics of each series of simultaneous technical sessions, morning, afternoon, and sometimes in the evening of each day of an annual meeting.

At the 1947 Annual Meeting this important backstage work, unnoticed by the average member, required the time of 36 experienced staff members, aided by 65 student members from 15 universities in addition to 20 convention aides supplied free by the Atlantic City convention bureau. Staff members were on the job from eight in the morning to eleven at night distributing and collecting equipment.

Important as is the backstage work of the Headquarters staff, the success of an annual meeting ultimately falls upon members of the Society who volunteer to plan and supervise the actual events. Their teamwork and skill is responsible for the satisfaction which the average member feels when he is present at a well-conducted session. At Atlantic City, the average session required the services of five members. As many as 17 members contributed to the Power Division panel, and in another session 20 members took part. Col. Elliott H. Whitlock, Fellow ASME, of Cleveland, Ohio, attended 20 sessions and other events in the first four days of the meeting. It was because 170 chairmen, recorders, and representatives of the president and Meetings Committee observed a rigid timetable and displayed superb teamwork that the 1947 Annual Meeting was so rewarding to more than 3000 members and guests.

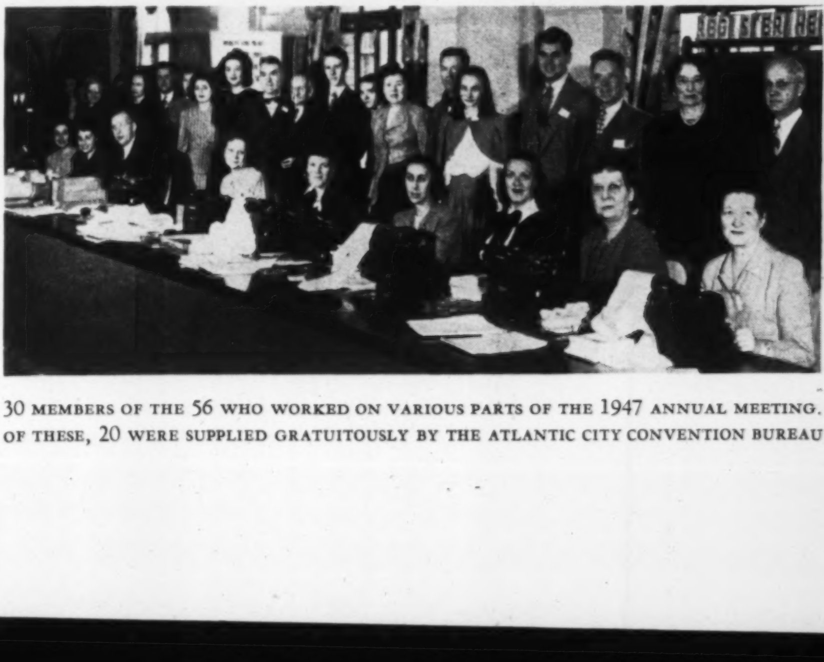
If an ASME annual meeting is a tremendous effort in execution, it is even more so in preparation, for each meeting is a 12-month effort beginning in one December and ending in the next. During this time the Society strives to prepare preprinted copies of all papers for distribution in advance of the meeting.

Publication Costs Are Heavy

At Atlantic City members found 145 of the 205 papers cast in the preprint form. Of these 47 were set in type by the Society's printer in Easton, Pa., and 58 were mimeographed by the staff. The remaining 40 were mimeographed by the authors. In all, 734 pages requiring 260,000 sheets of paper, not including many hundred pages of photographs, were prepared. In addition to staff time and printing costs, the publication effort costs the Society $50 for stencils alone and more than $700 for paper.

Three articles appeared in Mechanical Engineering in advance of the meeting to inform members of the high lights and the tentative program of the sessions. More than 25,000 copies of the general announcement were sent to members and some 5000 posters were distributed to engineering organizations for posting on bulletin boards. The programs of six professional divisions were sent to members of those divisions and several hundred copies were sent to members who requested them as a result of an offer in Mechanical Engineering.

For those who did not attend, the editorial staff prepared a 26-page report of the meeting which was published in the January issue of Mechanical Engineering.



30 MEMBERS OF THE 56 WHO WORKED ON VARIOUS PARTS OF THE 1947 ANNUAL MEETING. OF THESE, 20 WERE SUPPLIED GRATUITOUSLY BY THE ATLANTIC CITY CONVENTION BUREAU

EJC Asks President to Push National Science Foundation

THE following letter suggesting that President Truman call together a small group representing scientists and the executive and legislative departments of the Government to agree on a basis for legislation on a National Science Foundation, was sent to the President on Dec. 29, 1947, by the presidents of the five constituent societies of the Engineers Joint Council.

"The undersigned presidents of the major engineering societies of the United States respectfully submit that the establishment of a National Science Foundation is a matter of vital national urgency which cannot suffer further delay. We are cognizant of the differences in views which have marked the consideration and have delayed the enactment of science legislation. Despite these differences, we believe there is substantial agreement on the objectives of the National Science Foundation and on the principles essential to successful organization and administration.

The need to establish the Foundation according to sound principles of government is recognized. Involved in consideration of the form of the organization, however, is the need to command and retain the confidence and support of scientists and qualified laymen by giving them an effective, responsible place in the Foundation's affairs. We believe this can be achieved to your satisfaction and theirs. We, therefore, respectfully express the hope that you may see your way to assume the initiative in causing competent consideration of science legislation by a small group representing yourself, Congress, and the scientists, for the purpose of coming to agreement on legislation which could be acted on and put into effect soon after the first of the year."

SCHEPPEND · DENKEN · SCHOUWEND · DOEN

MEDALLION PRESENTED TO THE ASME AT THE CENTENNIAL CELEBRATIONS OF THE ROYAL NETHERLANDS INSTITUTE OF ENGINEERS THE INSCRIPTION READS: CREATIVE THINKING—GREAT DEEDS

The letter was signed by E. M. Hastings, president, ASCE; Clyde E. Williams, president, AIME; E. W. O'Brien, president, ASME; B. D. Hull, president, AIEE; and Charles M. A. Stine, president, AIChE.

Pan-American Engineering Body Favored by South American Engineers

REPRESENTATIVES of seven American countries including the United States, recommended unanimously the organization of a Pan-American Association of Engineering Societies and the postponement of the projected 1948 Congress of South American Engineering Societies in favor of a 1949 Pan-American Engineering Congress. These actions were taken at a meeting of American engineers in Lima, Peru, Nov. 28, 1947, sponsored by the Federation of South American Engineering Societies (USAI).

James S. Thompson of the McGraw-Hill Book Company, Inc., attended the meeting as representative of the Committee on International Relations of the Engineers Joint Council.

The following resolution was submitted to the Board of Directors of the USAI:

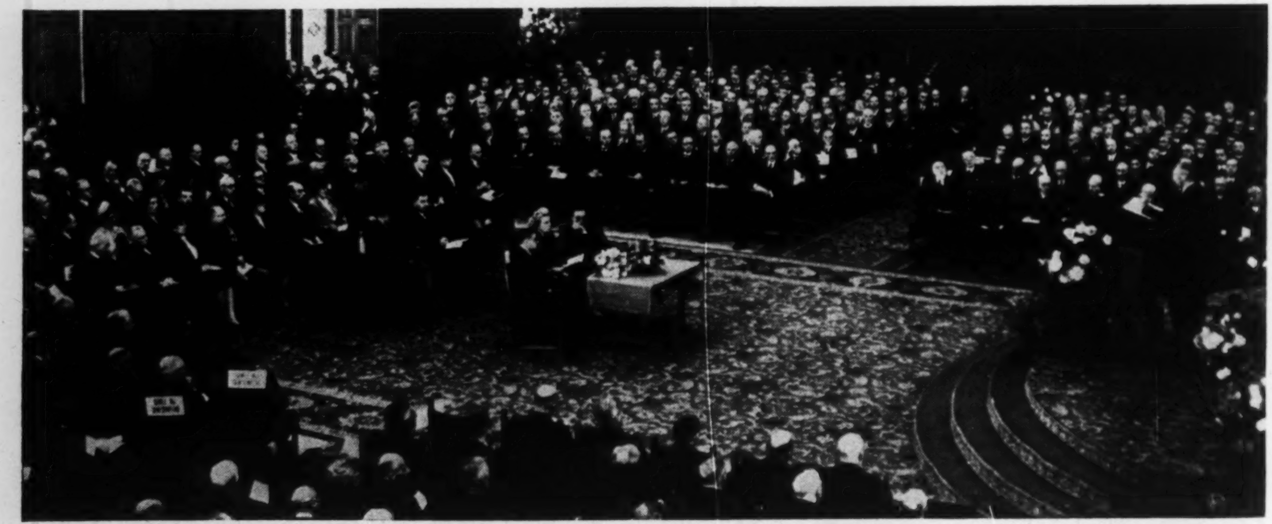
That the participating delegates and official representatives here assembled, who are meeting in accordance with the action of the Board of Directors of USAI and at the initiative of the Argentine Executive Committee of that organization, are unanimously agreed upon the desirability of the organization of a Pan-American Association of Engineering Societies and believe that a convention for this purpose should take place in the city of Bogota during the year 1948, which convention would be called under the auspices of the Board of Directors of USAI.

Since a meeting of USAI, limited to South American engineering societies, was planned for Rio de Janeiro in 1948, this group in Lima believes that it would be desirable to expand the latter Congress into the Pan-American Engineering Congress and hold it during the month of March, 1949.

C. B. LePage Dies in Hartford, Conn.

CLIFFORD B. LEPAGE, assistant secretary ASME, died suddenly in Hartford, Conn., Jan. 15, 1948, shortly after leaving a technical committee meeting.

Because of the breadth of his participation in the engineering activities of the ASME and other organizations associated with it in promoting the interests of the profession, his passing is a real loss to the Society.



THE PRESIDENT'S ADDRESS DURING THE CENTENNIAL CELEBRATIONS OF THE ROYAL NETHERLANDS INSTITUTION OF ENGINEERS

(The meeting took place in the Ridderzaal or Knight's Hall in The Hague, Sept. 23, 1947. In the center are Mr. Sickinghe, representative of Her Majesty, Queen Wilhelmina, also HRM Princess Juliana and HRM Prince Bernhard. Behind them are seated representatives of foreign engineering societies. S. E. Reimel, member ASME, and secretary, EJC Committee on International Relations, represented the ASME. Following the presidential address, commemorative medallions were presented to the honored guests.)

THE BOILER CODE COMMITTEE OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

(*Seated, left to right*: A. C. Weigel, C. W. Obert, W. P. Gerhart, Martha Jurist, D. S. Jacobus, honorary chairman, H. B. Oatley, chairman, C. A. Adams, V. M. Frost. *Standing*: C. O. Myers, P. R. Cassidy, F. S. G. Williams, J. W. Turner, A. J. Ely, D. L. Royer, H. C. Boardman, A. L. Penniman, Jr., R. E. Cecil, W. F. Hess, Walter Samans, S. K. Varnes, D. B. Rossheim, E. C. Korten (alternate for W. D. Halsey), T. H. Currier, secretary. Other members of the committee are H. E. Aldrich, F. W. Davis, and James Partington.
The Committee recently completed 37 years of service in the interest of public safety. Its rules guide the boiler and pressure-vessel industry in the United States, Canada, and in some of the countries trading in the United States. The ASME Boiler Construction Code has served as basis for pressure-vessel laws in 28 states of the Union and provinces of Canada.)

ASME Board on Honors Prepares Manual on Policies

TO ENCOURAGE ASME members and officers of the Sections and Professional Divisions to nominate candidates for the various ASME awards, the Board on Honors has recently prepared a manual of standard policies and practices which explains the awards under its jurisdiction and outlines the steps which must be taken to nominate candidates.

The 21 honors and awards administered independently by the ASME or jointly with other professional Societies are so diversified in their "deed of gifts" that the task of electing worthy recipients is a formidable one for the Society's Board on Honors.

The honors bestowed by the Society vary from those conferred on older men in recognition of permanent contributions to the welfare of mankind, to those made to students and undergraduates to encourage and inspire these young men to achievement in their chosen profession. In selecting those honored, the Board must exercise a high degree of care and responsibility. Its work can be performed more effectively if all elements of the Society participate in this important Society function by calling attention of the Board to men worthy of its awards.

ASME and Joint Awards

Among the awards bestowed jointly with other societies are: John Fritz Medal, Hoover Medal, Washington Award, Gantt Medal, Daniel Guggenheim Medal, Alfred Noble Prize, Marston Medal, Pi Tau Sigma Medal, and the Richards Memorial Award.

The independently administered medals of the Society are: ASME Medal, Charles T. Main Award, Freeman Award, Holley Medal, Junior Award, Melville Medal, Spirit of St. Louis Medal, Spirit of St. Louis Junior Award, Worcester Reed Warner Medal, Student and Postgraduate Awards. In addition, several honorary memberships are conferred annually on distinguished men. Not all of these honors are conferred annually.

All members or agencies of the Society such as committees, Sections, or Professional Divisions, are encouraged to submit nominations for the various awards on or before March 1 of each year. Each nomination should be supported by the following: (1) Full statement of the training, experience, and notable contribution of the nominee; (2) statement of the basic reasons for submitting the nomination and for believing the nominee is eligible for the honor; (3) other information or reference which will assist the Board in considering the nominee.

Awards for 1948

Honorary Memberships. Five may be awarded each year. The Constitution provides the recipients shall be persons of "professional eminence." These awards are not limited to Society members. A nominee must be endorsed by 25 members.

ASME Medal. This award is made for distinguished service in engineering and science, and may be conferred in recognition of general service in science having possible application in engineering.

Holley Medal. The award is made for some "great or unique act of genius of an engineering nature that has accomplished a great and timely public benefit."

Worcester Reed Warner Medal. This award is made to honor the author of an outstanding contribution to permanent engineering literature. Permanent engineering literature may be a book, a series of books, a single paper or a series of papers, which have been recognized as important additions to engineering literature by the profession.

For copies of the Manual, write to the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

R. E. Flanders to Receive 1948 Washington Award

SENATOR RALPH E. FLANDERS, Fellow and past-president ASME, has been elected to receive the Washington Award for 1948.

The award is presented annually by the Western Society of Engineers to an engineer whose activities have evidenced a serious interest in the welfare of his fellow man.

ASME Calendar

of Coming Events

March 1–4, 1948
ASME Spring Meeting
New Orleans, La.

May 20–22, 1948
Oil and Gas Power Division Meeting
St. Louis, Mo.

May 30–June 4, 1948
ASME Semi-Annual Meeting
Milwaukee, Wis.

Nov. 28–Dec. 3, 1948
ASME Annual Meeting
New York, N. Y.

Welding-Engineering Degree Offered by Ohio State

THE Ohio State University has recently established a department of welding, it has been announced by President Howard L. Bevis.

In the college of engineering at the University, the new department will offer undergraduate work leading to the degree of bachelor of welding engineering and advanced study for graduate engineers.

A pioneer in the field of welding engineering, Ohio State's college of engineering has offered a curriculum in this field for some nine years, as a division of the department of industrial engineering.

Curricula designed to meet the demands of industry for welding engineers will be developed in consultation with leading engineers in the nation, Dr. Bevis said.

ASME Society Records Sent on Request

MEMBERS of The American Society of Mechanical Engineers who wish to receive copies of the December, 1947, issue of the Society Records containing memorial biographies, and the February, 1948, issue containing committee personnel, are requested to fill out and mail the accompanying form, or order by letter, addressed to the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

The December issue contains memorial biographies of the following members:

Maurice Blair
Roger S. Boles
William H. Borden
Julius Credo
Charles C. Davis
William M. Dollar
William A. Drewett
Alexander S. Garfield
Robert H. Good
Morgan J. Hammers
George O. Haskell
Thomas Hawley
Nelson P. Hinman
Lawrence J. Holmes
William H. Honiss
George S. Humphrey
Homer L. Jones
George H. Landfear
John A. Larocca
Frank S. Lewis
Henry Lipps, Jr.
Claudio J. Martinez
James S. McLean
James E. McMillan
Lester G. Metcalf
Ora C. Montgomery
Virginius D. Moody
J. Arnold Norcross
Edson R. Norris
John Prentice
Horace H. Robinson
Alfred A. Rogers
Franz H. Schwarz
Joseph E. Selleck
Paul J. Zirkel

Please send me a copy of the Society Records for

☐ December, 1947 (Biographies)

☐ February, 1948 (Personnel)

Name..............................

Address..............................

....

Heat Transfer Division Honors Former Member

AS a tribute to the late E. D. Grimison, the following memorial minute was adopted at a meeting of the Executive Commitee of the ASME Heat Transfer Division held during the 1947 Annual Meeting in Atlantic City, N. J.

"The Executive Committee of the Heat Transfer Division records, with great regret, the untimely death of E. D. Grimison on January 11, 1947. He was one of the early active members of the Division and served successively as chairman of several committees and as chairman of the Executive Committee in 1941. He had been an advisory associate from 1941 until his death. His work in the field of heat transfer was of such basic nature and high quality that it will remain for all time as an outstanding landmark in the early development of this branch of science and engineering. We consider it a distinct privilege to have had his earnest and co-operative association in all our activities for the past ten years."

Report on Engineering Profession Available

COPIES of "The Engineering Profession in Transition," a report of the Engineers Joint Council on the 1946 survey of the engineering profession, are now available at $1 each through the Publications Sales Department of the ASME, 29 West 39th Street, New York 18, N. Y. Andrew Fraser of Washington, D. C., acted as special consultant to the EJC survey committee throughout the development and execution of the survey and is author of the report.

Committee work on the survey began in 1945 when it was decided that the survey would be based on a completely precoded mail questionnaire to meet three major objectives: (1) To determine the general impact of World War II upon the profession in the period 1939 through 1946; (2) to obtain reliable data from which valid findings could be derived to predict the activity pattern of the profession subsequent to the year 1946; and (3) to determine if the war's upheaval had changed materially the pattern of professional activities, education background, and earnings from those which existed prior to 1939.

A summary of the report was published on pages 732–734 of the September, 1947, issue of MECHANICAL ENGINEERING.

New ASME Publications

A COMPILATION of data on Diesel-engine operating costs for 1946 has recently been published by the Oil and Gas Division of The American Society of Mechanical Engineers in a 39-page booklet, "Report on Oil-Engine Power Cost for 1946." This is the sixteenth annual survey of cost and performance data and covers 126 oil-engine generating stations containing 399 engines which generated more than half a million kilowatthours during 1946.

Included in the report is such significant information as: type of plants and load, number of engines, total capacity, total hours of operation, gross and net output, percentage of gross output used in plants, annual plant load factor, and running plant capacity factor. Important data on engine and plant operating statistics are given, a summary of plant operating statistics, and cost data for each plant over the entire period for which information is available.

"The Study of Missiles Resulting From Accidental Explosions—A Manual for Investigators," by Crosby Field, colonel, Ordnance Department Reserves, U.S.A., and Fellow ASME, has also been published by the Society and is available in a 61-page booklet containing illustrations and examples of all the kinds of paper work, charts, maps, and such materials necessary to every type of investigation. The study is intended as a guide for those who may be confronted by the necessity of making similar investigations, and the justification of the procedure presented is the fact that it has been successful in practical application. The subject is approached from the viewpoint of ascertaining the causes of explosions in order that they may not recur. The procedure described by Colonel Field has already saved thousands of lives and it is hoped that continuation of its application by others will result in the saving of many more.

Copies of the booklets are obtainable from the Publication Sales, ASME, 29 West 39th Street, New York 18, N. Y., at $1.50 each, less 20 per cent discount to members of the Society.

Research Administrators Hold Conference

RESEARCH administrators of approximately 100 research laboratories met recently to discuss the daily and long-range problems involved in the expanding program of American research. The occasion was the Conference on the Administration of Research sponsored by the Pennsylvania State College, School of Engineering, under Dean Harry P. Hammond.

Of the laboratories represented, 40 belonged to industrial corporations, 40 to universities, and the remainder to government and other agencies. R. A. O'Brien, ASME staff research assistant, represented the Society.

Among the topics discussed were: Place of research in corporate structure; organization of individual research projects; form and usefulness of research reports, policies on publications; analyses of research costs; and others.

Games Slayter Honored by IRI

GAMES SLAYTER, vice-president in charge of research and development of Owens-Corning Fiberglas Corporation, has been chosen to receive the 1948 Industrial Research Institute medal presented for outstanding contribution to the field of industrial research. The medal will be presented Feb. 5, 1948, during the winter meeting of the Institute at Rye, N. Y.

ASME Junior Forum

COMPILED AND EDITED BY A COMMITTEE OF JUNIOR MEMBERS, C. H. CARMAN, JR., CHAIRMAN

Philadelphia Junior Group Operates Under New Organization Plan

AS a basis for reorganization, the Junior Group of the ASME Philadelphia Section prepared an organization chart and plan which outlines organization structure, procedures, and the duties of the principal officers. Behind the project was the idea that the war-wrecked program of junior activities should be expanded so that more junior members could benefit by assumption of responsibility in some ASME activity. Not only does the plan consider the welfare of junior members but also that of student members in near-by universities, who are soon to join the ranks of ASME junior members.

The organization chart of the Philadelphia junior group appears on this page.

The offices of chairman, vice-chairman, and secretary-treasurer are elective. Other offices are filled by the chairman or jointly by the chairman and vice-chairman.

The principal duty of the chairman is to represent the Junior Group in general Section matters. He is freed of the responsibility for planning, a duty specifically delegated to the vice-chairman.

Of interest are the offices of junior-relations chairman and student-relations chairman. The duties of the first are to keep in touch with junior activities of other junior groups in the ASME and in other professional organizations. The incumbent is in effect an "ambassador at large" of the Junior Group.

Upon the student-relations chairman falls the responsibility for maintaining contact with student branches at local universities, sponsoring joint programs, and inviting students to junior meetings. He is in charge of the important function of acquainting students with the advantages of Society membership.

Juniors who would like a copy of the plan can obtain one by writing to Albert Schade, 3rd, United Engineers and Construction, Inc., 1401 Arch St., Philadelphia, Pa.

Where to Begin?

MANY times juniors feel at a loss how to begin to become active in Society affairs. This is understandable for often the Society appears to them a thing remote. After all, about their only contact with it may have been through the Society publications and, perhaps, an occasional meeting or two at which everyone seemed a stranger. Consider the young college graduate who, having left the friendly atmosphere of the campus, is now hard at work in the rigid and somewhat formal business world. Perhaps he is even in a strange locality where the situation is more intensified. The problem becomes: How can such a man begin this work on Society matters when everything appears to be so remote?

The answer is here; right in the pages of the "Junior Forum." It must be remembered that to provide such answers was one of the main objectives in starting the "Forum." Let us assume you want to be active, what then? Should you write to the "Forum" and say, "Here I am, what do I do?" This is fine but doesn't carry the matter far enough. You must realize how complex the Society's organization is and make an analysis to see with what branch or function you wish to become affiliated. With this thought in mind we recommend that every junior who is unfamiliar with ASME structure read the pamphlet, *Know Your Society*, which records the various divisons and functions. Copies of this booklet may be had by writing the "Forum."

After you have given this matter some thought you will then be able to decide whether you want to serve as junior adviser to one of the technical committees on codes and standards, such as safety, power test codes, or to a committee concerned with meetings, publications, and professional divisions. There are other committees which work on such problems relative to engineering such as education, registration, and civic responsibility. It is readily seen that it would be a mistake to assign a man to work with a technical committee when his real interest lies in problems of education.

Summing up, to become active proceed as follows: First determine where your interest lies; then check to see what the possibilities are for local or group activity; check with the "Junior Forum" telling them of your preferences. It is as simple as that. We assure every junior who writes to us that his letter will be given consideration and attention. Therefore, "let's begin."

Don't Be Afraid of Opportunity

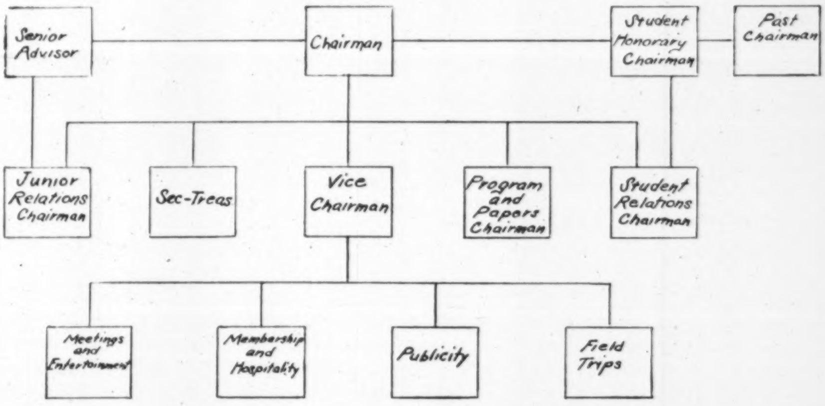
To the Editors:

AFTER the article in the October "Forum" on unionization of engineers I thought it would be of interest to fellow juniors to read of the changes that can and do take place in the development of the career of a junior.

Immediately after graduation, my professional career started with one of the largest capital and durable consumer-goods producing companies in the U.S.A. Without a doubt this company employs the largest engineering staff in the U.S.A., over 6000 graduate engineers, plus a full staff of draftsmen, technicians, and assistants. In an organization of this type the work tended to be and was of a specialized nature. For the asking were to be had the aid of the purchasing, planning, manufacturing, tool design, and testing departments, as well as that of the research laboratories, works laboratories, and specialists, to solve specific problems. The counsel and advice of older engineers was always available. In fact, more than half the job was knowing to whom to turn with your pet problem or headache. The job was the development and design of a specific piece of equipment, for one specific duty.

From this intricate organization I was catapulted, or rather sprung, into one of the opposite complexion. To make it even more interesting it was in a foreign country—2300 miles from the sources of raw materials,

ORGANIZATION CHART


Senior Advisor
Chairman
Student Honorary Chairman
Past Chairman
Junior Relations Chairman
Sec-Treas
Vice Chairman
Program and Papers Chairman
Student Relations Chairman
Meetings and Entertainment
Membership and Hospitality
Publicity
Field Trips

ORGANIZATION CHART OF THE JUNIOR GROUP OF THE ASME PHILADELPHIA SECTION machinery, spare parts, and technical advice or help. Here I was (and am) the sole engineer or technical man and, perforce, expert in everything. I have become the purchasing department, lab, maintenance foreman, planner, production man, expediter, trouble shooter, labor-relations expert (in Spanish), and, like Figaro, the factotum of the outfit. To confess, I had longed for a small company and I got it to the *n*th degree.

From a minutely circumscribed and carefully watched responsibility, the full undivided and inescapable responsibility for the whole was given me. From a specific design job in the field of mechanical engineering, I went to a general administrative and technical job in the plastics-molding industry. From almost utter dependence upon others for advice and help, I had to develop total independence. From the heart of a great industrial area, I landed where the procurement of even the simplest spare part is a task. And from an environment where engineers, especially junior ones, are quite anonymous and not quite as important as a good oldtime union sweeper, to a country where every engineer is addressed by title.

While at the beginning of the violentchange, the need to meet situations, either totally unknown or remotely touched upon in school and in previous experience, at times caused a slight weakness in my underpinning, the net results have been highly satisfying from the point of personal ego and professional development.

It is too easy to settle for security alone. Unionization encourages this. But for it we often trade change and risk, taking which, unfortunately or otherwise, is linked to opportunity.

Fellow juniors, I realize that this has been a highly personal account. Please forgive the "I's." But I know that there are many of you now at the crossroads—"Shall I?" or "Shan't I?" My advice is "Come on in, the water is fine."

LAWRENCE ZOLLER.[1]

About Engineers

R. B. WHITE, president of the Baltimore and Ohio Railroad Company, speaking at a luncheon meeting of the Engineers Club of Baltimore, recently had this to say about engineers:

> I have come in contact with many engineers of different kinds and in almost every kind of work. I might hastily classify them as good, fair, and not so good—some tempermental, some stubborn, but mostly co-operative, capable, and willing. Some, in my opinion, made a mistake in trying to become an engineer—intelligent, but not fitted—and would no doubt have been more successful in some other line of work. A very important qualification for an engineer, in my opinion, is vision and imagination, which of course must be accompanied by the one essential for all worth-while success—common sense.
>
> Over the years I believe the most prevalent weakness of most engineers is to overengineer a job, and I hope you will understand what I mean. This weakness is perhaps even more outstanding in designing engineers and architects. It is not always easy to differentiate between the desirable and essential, and sometimes the former adds heavily to the cost. It is so often much more economical to let some imagined or infrequent occurrence happen than it is to make the expenditure necessary to prevent or guard against it. Too, I find highly competent engineers often fall into two classes —those who are always in the mood of willing to be consulted, and those whose imagination is working and they are "rarin' to go." I prefer the latter. I would rather drive a horse I had to hold than one I had to whip to get him moving. The men who have gone the farthest, it seems to me, are those who have been both willing and capable of mixing a reasonable amount of common sense with their technical knowledge, in the proper proportions.

Home-Workshop Creations

WHO are the mechanical engineers who have built unique mechanical devices "on their own time?" There must be many who are modestly proud of their own home-workshop creations. We've read (in *Chemical Engineering*) of Paul De Vries, who added a fuel-oil carburetor and auxiliary throttles to his car, for more miles of wartime driving, using the gasoline carburetor only for starting. Then there are some rocket enthusiasts in Schenectady who built a small rocket of modern design, using Fourth-of-July skyrocket powder for propellant. In testing the rocket at an airport, simultaneous observations of altitude versus time were made from two directions. Let's hear about some similar creations or applications, preferably by or about ASME junior members.

Encourage junior members who you know are doing interesting work to take photographs of their creations and to send these to the "Forum" for possible publication.

The Love of Books

"IT IS to be considered what convenience of teaching is in books, how easily, how secretly, how safely in books we bear, without shame, the poverty of human ignorance.

These are masters who instruct us without rod and cane, without words and wrath, and for no clothes or money. If you approach them they are not asleep; if you question them they are not secret; if you go astray they do not grumble at you; they know not how to laugh if you are ignorant.

O books, ye only are liberal and free, who pay tribute to all who ask it and enfranchise all who serve you faithfully."

These words, written some six centuries ago by a great reader and collector of books, Richard of Bury, Bishop of Durham, England, were used in an illuminated document marking the election of The Engineering Institute of Canada to membership in the Engineers' Council for Professional Development. The document is now in the Library of the Canadian Club of New York, N. Y.

Postgraduate Training for the Engineer

THE first of a possible series of meetings on what the graduating and junior engineer may expect in the way of training within industry in the first few years of his professional career was held in the Engineering Societies Building, New York, N. Y. on Nov. 14, 1947 with an attendance of over 140 interested young men.

This meeting, sponsored by the Junior Group of the ASME Metropolitan Section, dealt with power-plant work. J. N. Langley, chairman of the Junior Group, introduced the speakers, who discussed many phases of a junior engineer's training.

J. B. Saxe of Gibbs and Hill, talked on power-plant erection and traced the development of a plant from the load studies through to the final testing. He pointed out how, after spending time on a drawing board, a man might enter either the design, adminstrative, or construction divisions. Since cost is a large factor, a trainee will also spend time in the estimating department. After the program, he might become an assistant in any one of the three divisions.

E. Parker of the General Electric Company, discussed a junior engineer's training in turbine design, construction, and testing. He pointed out that it was a highly specialized job, necessitating experience, teamwork, common sense, judgment, and the ability to work. At General Electric, a trainee will spend considerable time in design and "on test," after which he might go into manufacturing, sales, service, and erection, or stay in engineering doing design or adminstration work. The particular field will depend on his preferences, personality, ability, and the demand. Mr. Parker pointed out that there was a place for every type of man in the heavy-equipment field.

J. Van Brunt, of the Combustion Engineering Company, then talked on what a man might expect if he went into boiler work. He would go through the boiler shop to learn the fabrication, the erection department to learn the construction, and the engineering department to learn design of boilers. He might also spend some time in the proposition department, which prepares designs and specifications for customers, the estimating department, or, perhaps, the sales department.

Paul Gravelle, of the Toledo Edison Company, discussed what a man graduating from an engineering school might expect if he went into central-station work. He started by discussing the auxiliaries which are so important for good power-plant operation, pointing out how failure of the fuel, air, or water supply could disrupt boiler operation. He showed how improvements in auxiliaries to provide greater operating efficiency have changed the type of personnel necessary. Mr. Gravelle stressed the need for practical experience, and pointed out the steps that a man might take in a training program. These were: experience on power-plant equipment and associated auxiliaries, combustion problems, operation troubles, routine and emergency operation, and maintenance, and most important, time in a "results group," which could be a stepping stone to supervision. He stressed that most executives and officials in central-station work have passed through some type of training course.

---

[1] Jun. ASME, Plant Manager, Distribuidores Generales de Mexico, Calzada de Tlalpan 1633, Mexico, D. F., Mex.

A. R. Mumford, of Combustion Engineering Company, and vice-president ASME Region I, closed the meeting by pointing out that while colleges are devoting more and more time to theory and hence the student gets little practical experience, the Society can call on experts in various fields to describe what the man might expect upon entering some particular field. He called for suggestions and comments from the audience on the idea of having a series of meetings on various subjects of interest to junior members.

Reported by R. G. BIEDERMANN.[2]

Philadelphia Junior Group Meets Monthly

FOR its 1947-1948 season the Junior Group of the ASME Philadelphia Section adopted a policy of holding monthly meetings on new developments in various fields of engineering. At the first meeting held at the Engineers' Club of Philadelphia on Oct. 8, 1947, sixty-five members and guests heard a talk by Lieut. K. M. Globus, U.S.N. of the U. S. Naval Aeronautical Experimental Laboratory, U. S. Naval Base, Philadelphia, on "Tri-Vision; A Three-Dimensional Photographic Process."

Lieutenant Globus outlined the basic components of "tri-vision," the Navy's new method for producing three-dimensional photographs. This method is still in the experimental stage. His talk was somewhat limited because the information he had prepared for presentation had been unexpectedly placed on the "restricted" list by the Navy the day before the meeting, but sufficient allowance was granted for him to outline general requirements.

The method, he said, uses standard photography, except for the fact that the back of the film is embossed. This provides for the characteristic of accepting many views. A large lens, 10 in. in diameter, is used. The camera is provided with a rectangular slot inasmuch as the process is concerned with light in a vertical plane only. Ordinary snapshot or flash bulb and standard developing techniques are used to produce pictures with astounding three-dimensional qualities. He said it was possible to "see" 23 deg around the object photographed on the final print. The method is not of the stereotype, and no special lenses or glasses are needed to obtain the three-dimensional effect. Several samples of these photographs were available for general inspection.

Lieutenant Globus' talk concluded with a short description of the Sonné camera which provides a method of photographically determining water depths at any beachhead and was extensively used by the Armed Forces in the Pacific invasion.

Chicago Juniors Discuss Unionization

TAKING its cue from the October "Junior Forum," the Junior Group of the ASME Chicago Section chose the topic of unionization of engineers as the subject of its first forum meeting of the 1947-1948 season.

Two speakers were selected: Ursa C. Stringer, president of Local 90-A, International Federation of Technical Engineers, Architects, and Draftsmen's Union, to present the side of the unions, and John A. Patton, president of the firm of John A. Patton, Management Engineers, Inc., to present the side of management.

To inform juniors of the program a circular letter was mailed to all junior members of the Section, and the Junior Group made a special effort to invite recent graduates and engineers new to the Chicago area.

The result of this planning and publicity was a successful meeting held October 8, 1947, in the Little Theater of the Civic Opera Building. More than 125 engineers representing all points of view attended. When the speakers concluded their formal statements, an active question-and-answer period followed, during which the opinions of the speakers were put to test.

While no formal conclusions were drawn, those who attended were able to appreciate better such phases of the problem as the advantages of union membership, employer relationship with union members, a union member's chances of advancement into management, and the possibility of loss of prestige resulting from union membership.

Metropolitan Juniors to Hear E. G. Bailey

PRES. E. G. BAILEY will address a meeting of the Junior Group of the ASME Metropolitan Section in the Engineering Societies Building, New York, N. Y., March 9, 1948. His subject will be "Industry and the Young Engineer."

At the same meeting he will present 50-year membership badges to S. H. Libby, E. S. Cole, B. F. Wood, and J. A. Tibbals.

Philadelphia Engineers Club Celebrates 70th Anniversary

THE seventieth anniversary of the Engineers' Club of Philadelphia, one of the oldest of its kind in the United States, was celebrated at a dinner at the Bellevue-Stratford Hotel, Philadelphia, Pa., Dec. 16, 1947. More than 800 engineers and guests attended.

Earl O. Shreve, member ASME, president of the Chamber of Commerce of the United States, who was guest speaker, paid tribute to the engineering profession by picturing engineering research as the "Aladdin's lamp of industrialization." While American engineers are working for peace, he warned, "engineers of destruction are also at work," engineers in Russia and those in France and Italy who are under the influence of communistic ideology. These men are the production tools of those working for world revolution, he said.

Philip H. Chase, member ASME, and president of the Engineers' Club, reviewed the history of the club which is affiliated with 11 engineering societies and has a membership of 6500.

According to Mr. Chase, the founding of the organization was inspired by the technological developments displayed for the first time at the Centennial Exposition held at Philadelphia in 1876. Prompted by the rapidly growing interest in scientific news, the club was organized to "secure and exchange information on engineering progress and projects, for the mutual benefit of its members."

Mr. Chase said many of the revolutionary technological developments introduced before the turn of the century were looked upon with suspicion, and the co-ordination of reliable scientific information marked a significant step which in later years contributed to the industrial progress of the country. "Morse's electric telegraph was the sole means of rapid, long-distance communication when the Club was founded, he said.

In his remarks as toastmaster, Horace P. Liversidge, member ASME, chairman of the board, Philadelphia Electric Company, said that "the war served to stress the importance of maintaining at all times a high degree of technological efficiency." It will be necessary, he added, to encourage engineering as a career and to provide engineering schools with financial support "if America is to retain its industrial pre-eminence."

Recorded ASME Speakers Available for Section Programs

FOR the use at student-branch meetings or before general engineering, civic, or community groups, the ASME Civic Responsibilities Committee has available recordings of General Motors' president, C. E. Wilson's address, "The Great Delusion—Where Marx Went Wrong." This address was published in the August issue of MECHANICAL ENGINEERING. Recordings are available also of L. J. Fletcher's address, "The Citizen Engineer, His Job." This address was published in the November issue of MECHANICAL ENGINEERING.

In great national demand as a speaker, Mr. Fletcher has been instrumental in developing workable programs for developing better community understanding between labor, farm, industry, and education groups.

The recordings of these addresses are available on 33 rpm radio-station-type records, for which the user will have to arrange his own broadcasting facilities. The ASME Civic Responsibilities Committee has available also a Brush Soundmirror and has these transcriptions on magnetic tape for playback on this Brush Soundmirror. Wire recordings will be made, if requested.

Those who wish to borrow this equipment should write to The American Society of Mechanical Engineers, 400 West Madison St., Chicago, Ill.

---

[2] Jun. ASME, Associate Mechanical Engineer, Airadio, Inc., Stamford, Conn.

ECPD Reports Increasing Use of Pre-Engineering Examinations

A STANDARDIZED examination, similar to the 25,500 experimental tests given on a nation-wide scale last year, may become an entrance requirement of American colleges of engineering as a result of increasing acceptance of a Measurement and Guidance Project begun in 1943 by the Engineers' Council for Professional Development in co-operation with the Carnegie Foundation for the Advancement of Teaching. Kenneth W. Vaughn of the Carnegie Foundation is director of the project.

Specially prepared examinations under the project include an engineering-science aptitude test, suitable for purposes of guiding high-school students and designed for use during the second year of high-school study; and the pre-engineering inventory, which is particularly appropriate for guiding and advising prospective engineering students who have completed secondary education.

During the past year, 40 colleges of engineering participated in one or more phases of the work of the project. Of these, 39 colleges, including branches, gave the pre-engineering inventory to all members of the freshman class entering in the summer or fall of 1946. In 1947 national examinations were conducted for 2600 prospective college students.

To evaluate the worth of pre-engineering examinations, the records of students in ten institutions were compared at the end of their freshman year with the results of their pre-engineering tests. Results substantiated the value of entrance examinations in predicting the students' degree of success in engineering training.

In reporting on progress, Dr. Vaughn stated that engineering educators are realizing increasingly that critically considered examinations can provide dependable measures of student ability and achievement.

Engineering Progress Show Planned for May 11–16, Philadelphia, Pa.

THE Engineers' Club of Philadelphia Junior Members, are joining with The Franklin Institute of the State of Pennsylvania in sponsoring a second Engineering Progress Show on May 11–16, 1948. Exhibits will include many items depicting the progress in engineering. The first show held in the spring of 1947 was highly successful, having an attendance record of over 10,000, and booths sold out to exhibitors in advance of the show date.

The show will be held in Franklin Hall in The Franklin Institute of Pennsylvania. In addition to the exhibits, two nationally prominent engineers will deliver lectures in the Franklin auditorium on two evenings during the week.

Exhibitors are now contracting for group space. The debut of many engineering advancements is expected to be made at this show.

Du Pont Offers Seven ME Fellowships

OF the 75 postgraduate fellowships recently announced by E. I. du Pont de Nemours and Company, Wilmington, Del., seven will be in mechanical engineering. These have been awarded to Columbia University, Cornell University, Lehigh University, Massachusetts Institute of Technology, Pennsylvania State College, Purdue University, and University of Michigan.

Each fellowship provides $1200 for a single person and $1800 for a married person, together with an award of $1000 to the university. Candidates and the problems on which they are to work are selected by the universities.

H. A. Hopf Honored by SAM

THE Taylor Key, the highest honor granted by the Society for the Advancement of Management, was presented to H. A. Hopf, member ASME, at the annual-meeting dinner of the society, held at the Hotel New Yorker, New York, N. Y., Dec. 2, 1947. The award is bestowed annually "for the outstanding contribution to advancement of the art and science of management as conceived by Frederick W. Taylor."

William E. Wrather to Head AIME in 1948

WILLIAM E. WRATHER of Washington, D. C., was elected president of the American Institute of Mining and Metallurgical Engineers, it was announced recently at the meeting of the Institute's board of directors. Dr. Wrather is director of the United States Geological Survey, which is under the Department of the Interior.

G. F. Hussey Appointed ASA Administrative Head

VICE-ADMIRAL George F. Hussey, Jr., USN retired, wartime chief of the Navy's Bureau of Ordnance, has joined the staff of the American Standards Association. He assumed duties as administrative head of that organization on Jan. 1, 1948. Cyril Ainsworth, who for a number of years has been in charge of the technical activities of the ASA, will serve with Admiral Hussey as director of operations of the ASA staff.

In accepting the appointment, Admiral Hussey will take over the tremendously increased administrative responsibilities from P. G. Agnew, under whose direction the ASA has progressed to its present high level. Dr. Agnew, one of the world's authorities on standardization, will continue his service to ASA as consultant.

The American Standards Association, faced with an unprecedented demand for service to industry, consumer, and Government, expects to increase its activities during the next year to approximately three times that of the largest year before the war. At the present time there are over 366 projects being carried on under ASA procedures with more pending.

Meetings of Other Societies

February 1–5
American Society of Heating and Ventilating Engineers, 54th annual meeting, Hotel Commodore, New York, N. Y.

February 15–19
American Institute of Chemical Engineers, New Orleans meeting, Hotel Roosevelt, New Orleans, La.

February 16–18
American Management Association, marketing conference, Hotel New Yorker, New York, N. Y.

March 1–5
American Society for Testing Materials, spring meeting, Washington, D. C.

March 3–5
Society of Automotive Engineers, Inc., national passenger-car and production meeting, Hotel Book-Cadillac, Detroit, Mich.

March 15–16
Illuminating Engineering Society, Canadian regional conference, Ottawa, Ont., Can.

March 15–19
American Society of Tool Engineers, annual meeting and tool engineers' industrial exposition, Hotels Carter, Cleveland, Statler, and Public Auditorium, Cleveland, Ohio

March 18–19
American Management Association, marketing conference, Hotel New Yorker, New York, N. Y.

March 30–April 1
Society of Automotive Engineers, Inc., national transportation meeting, The Bellevue-Stratford, Philadelphia, Pa.

April 7–9
American Society of Civil Engineers, spring meeting, Pittsburgh, Pa.

April 8–9
National Machine Tool Builders' Association, spring meeting, The Drake Hotel, Chicago, Ill.

April 13–15
Society of Automotive Engineers, Inc., national aeronautic and air-transport meeting, Hotel New Yorker, New York, N. Y.

Sections

Pittsburgh's Industrial Outlook Discussed by ASME Pittsburgh Section

THE Pittsburgh district is in for a decline in coal production unless new uses for coal are realized, according to Joseph Pursglove, Jr., vice-president, Pittsburgh Consolidation Coal Company, Pittsburgh, Pa., who spoke to more than 300 engineers at a meeting sponsored jointly by the Pittsburgh Section of the ASME and the Engineers' Society of Western Pennsylvania, on Nov. 10, 1947.

Mr. Pursglove was one of four speakers, each of whom discussed one of the four vital components which make up Pittsburgh's industrial activity; coal, steel, small industries, and transportation.

The other speakers were: J. E. Lose, vice-president, Carnegie-Illinois Steel Corporation, who spoke on the outlook of the steel industry; Birger Engstrom, vice-president, McDowell Manufacturing Company, who discussed the importance of smaller manufacturers to the Pittsburgh area; and Charles Donley, transportation specialist of the firm of Charles Donley and Associates, who covered the advantages to be gained from improving waterway transportation facilities for the port of Pittsburgh.

Mr. Pursglove said that while the coal reserve in the ten Western Pennsylvania counties was estimated at 30 billion tons, the low cost and better-quality coal deposits were being depleted rapidly and that new mines were going to require much greater development costs.

Another factor contributing to the pessimistic outlook, he stated, was the smoke ban that would take away the last remaining natural market for Western Pennsylvania coals unless smokeless stoves and furnaces, stokers, and other approved coal-burning equipment are made available and purchased and installed by users before the customers go to substitute fuels.

Discussing Pittsburgh's waterway facilities, Mr. Donley said that while 30 million tons of bulk traffic move annually on the rivers of the Pittsburgh district, the waterways are not well utilized for the distribution of finished products. Over 95 per cent of the bulk traffic constitutes a private commerce between industry and industry.

Because there are 174 major industries within a 10-mile radius of the Point, 107 of which are within the 5-mile radius, the district is well prepared to support and to benefit from a "well-regulated waterways commerce in merchandise traffic" if public terminal-warehouse and handling facilities were made available in Pittsburgh, he said.

He concluded with a warning that if the Pittsburgh area was to keep pace with its competition, located at more strategic places with modern facilities for low-cost transportation, the area must make more use of its natural transportation advantages.

AT THE MEETING OF THE ASME PITTSBURGH SECTION

(*Standing, left to right:* E. W. Jacobson, J. Pursglove, Jr., and H. H. Hall. *Seated:* J. E. Lose, Birger Engstrom, and Charles Donley.)

Akron-Canton Section Hears Talk on Sleeve Bearings

A dinner meeting was held on Nov. 20 at Wetch's Tavern, Akron, Ohio, with 24 members and 10 guests present. The program was a talk by Edwin Crankshaw, member ASME, assistant chief engineer, Cleveland Graphite Bronze Company, on "Design and Lubrication of Sleeve Bearings." Mr. Crankshaw stressed the new type thin-case bearings backed by secondary bearing materials. He also spoke on the principles of lubricating sleeve bearings, and accompanied his talk with slides.

Anthracite-Lehigh Valley Section Has Two Meetings

A meeting was held on Nov. 13 in the Tatamy Fire House, Tatamy, Pa., at which time a talk was heard by an audience of 165 on "Lightweight Plane Manufacturing." William T. Piper, Sr., the speaker, gave an interesting history of light-plane manufacture, as well as describing his own part in its development. He expressed confidence in the bright future of light planes and gave the audience some ideas of future plans of his company.

On Nov. 21 at the Berkshire Hotel, Reading, Pa., A. L. Wentzel spoke to an audience of 23 on "Advancement of Foundry Industry." Mr. Wentzel said that castings have a very definite place in industry and that engineers could rely on castings as never before. He devoted a large part of his talk to the effects of Allied bombing raids on German heavy industry, showing the relatively minor effect on these industries.

Birmingham Section Hears John M. Gallalee

At the Bankhead Hotel, Birmingham, Ala., on Nov. 17, John M. Gallalee, member ASME, head of the department of mechanical engineering, and director of the technical staff of the Alabama State Building Commission, spoke on "Functions and Activities of the State Building Commission." Dr. Gallalee told of the work of the Commission in its efforts to spend state building funds wisely under present-day conditions.

Charles E. Joos Speaker at Boston Section

Charles E. Joos, Cochrane Corporation, Philadelphia, Pa., was the speaker at the meeting on Dec. 18 at the Massachusetts Institute of Technology, Cambridge, Mass., before an audience of 75. His subject was "Rational Selection of Feedwater-Conditioning Equipment." Mr. Joos, who has had a background of 25 years' association with the design, manufacture, and operation of water-softening and conditioning equipment, approached the subject from an economic, as well as technical standpoint, giving due weight to chemical costs, original equipment costs, and building requirements of the installation. Slides showing equipment and tabulations of chemical costs, based on water characteristics per unit of water flow were presented. The relative merits of different systems were briefly presented.

Mechanisms Topic at Buffalo Section

On Nov. 12 at the Hotel Touraine, Buffalo, N. Y., 40 members and 35 visitors heard J. W. May, member ASME, chief engineer, design and research, Wright Automatic Machinery Company, Durham, N. C., talk on "Mechanisms—Discussion and Analysis of Intermittent Motion." Mr. May explained various linkages, their economics and history, and their usage in place of cams on products being developed by his company. His talk was aided by use of full-scale models of linkages.

Chicago Section Hears Talk on High-Speed Camera

On Dec. 18 at the Chicago Engineers Club, J. J. McDevitt, Western Electric Company, New York, N. Y., spoke on "The Fastax Camera." Mr. McDevitt described this Western Electric camera developed by Bell Telephone Laboratories, and capable of taking pictures at the rate of 10,000 per second. A movie showing various applications of the Fastax camera in industry was shown. After this showing Mr. McDevitt answered many

A. B. OPENSHAW, CHAIRMAN, MEMBERSHIP AND ATTENDANCE COMMITTEE, ASME CHICAGO SECTION

questions, and a model of the camera was on display. This meeting was under the auspices of the machine-design division of the Section.

Steel Situation Discussed at Dayton Section

On Nov. 25 at the Engineers' Club of Dayton, Ohio, an audience of 125 heard a talk entitled "The Steel Situation," by R. C. Todd, sales consultant, The American Rolling Mill Company. Mr. Todd presented pertinent facts and figures regarding the production and earnings of the American iron and steel industry previous to and during the past 7 years. He spoke spiritedly on the problems resulting from governmental actions regarding pricing practices, the scrap and ore reserves, the increased cost of replacing war-depleted capital equipment, and the need for new capital.

East Tennessee Section Enjoys Inspection Trip

On Dec. 12 an excellent inspection tour was made by 77 members to the new north plant of the Aluminum Company of America. This trip was arranged by Ralph Ferry, member ASME, of that company. After the tour a buffet supper was served, and W. E. Roberts of the Aluminum Company, gave a short talk on some of the details of the plant. A new movie "This Is Aluminum" was shown. Thanks are due to the Aluminum Company for such a fine meeting.

Talk on Industrial Peace at Fairfield County Section

The vital importance of the engineer in the long-range search for industrial peace was stressed by John Q. Jennings, director of industrial relations, Bridgeport Brass Company, in an address before the meeting of the Section on Nov. 29. In answer to the question, "Can we have industrial peace?" Mr. Jennings concluded that three principal problems were involved: (1) How successfully management and labor practice the good human relations which are the foundation of good industrial relations; (2) how well the Taft-Hartley Act works; and (3) how successful labor and management are in solving the three-cornered problem of wages, prices, and profits through collective bargaining between themselves and through increased operating efficiency on the part of management and the employees. It was on this latter question that the speaker stressed the role of the engineer.

Fort Wayne Section Hears Talk on the Heat Pump

On Nov. 7 at the G. E. Squares Club, Fort Wayne, Ind., an audience of 80 heard W. E. Johnson, member ASME, manager of engineering in air conditioning, General Electric Company, Bloomfield, N. J., talk on "Theory and Application of the Heat Pump." Mr. Johnson said that the use of heat pumps for both summer and winter air conditioning is now economically feasible where electricity rates are low and winter temperatures are not too cold. Though available for homes, most installations during the next ten years are expected in commercial buildings. Thermodynamics at the cycles were completely explained using slide-projected charts. It is believed that other Sections would be interested in this lecture.

"The Compudex" was the subject at the Dec. 4 meeting in the Chamber of Commerce, Fort Wayne, Ind. Steve Wells, the speaker, said that the Compudex is a device for rotary indexing which automatically and accurately divides a circle into any number of parts up to 1099, including prime numbers. Taking the place of ordinary pinhole plates for indexing, the device saves operation time, greatly reduces opportunity for error, and is extremely accurate when used as an addition to milling machines, jig borders, gear shapers, and reamer and broach grinders. Eighteen were present.

Greenville Section Holds Dinner Meeting

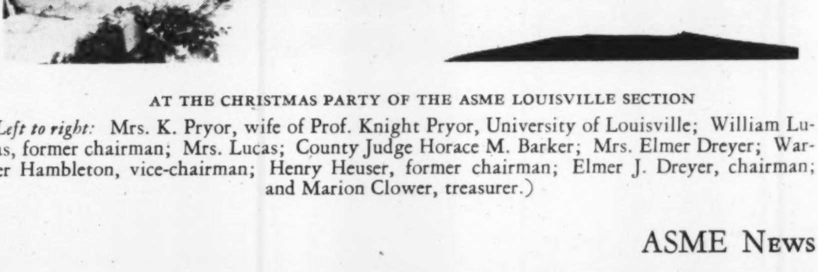
A meeting was held on Nov. 7 at the Poinsett Hotel, Greenville, S. C., with chairman John C. Whitehurst presiding. After dinner, the visitors were introduced to members. A certificate of award was presented to Dr. J. H. Sams, member ASME, vice-dean, school of engineering, Clemson College, and past-chairman of the Section, by E. E. Williams, vice-president, ASME Region IV. The speaker was Allan T. Shepherd, Allan T. Shepherd Company, Richmond, Va., representatives of the Armstrong Machine Works, Three Rivers, Mich. Mr. Shepherd illustrated his talk with a film entitled "Trapping for Profit," A lively discussion period followed. In the audience were members of the Clemson College branch.

Talk by Police Lieutenant Feature at Hartford Section

On Nov. 18 at the City Club, Hartford, Conn., 50 members and 20 guests heard a talk by Lieut. Frank B. Champeroy on "Identification Procedures in Police Investigation." He explained the scientific methods employed in the identification of persons and detection of crime and illustrated with slides from official police files.

Inland Empire Section Hears Talk on the Heat Pump

George S. Smith of the University of Washington, was the speaker at the Dec. 29 meeting in the Davenport Hotel, Spokane, Wash. His subject was "The Economics of the Heat Pump." Dr. Smith showed that the heat pump for residential heating was as economical to operate as heating by coal or oil. He said that further investigation is advisable to insure proper specifications for suitable equipment.



AT THE CHRISTMAS PARTY OF THE ASME LOUISVILLE SECTION

(*Left to right:* Mrs. K. Pryor, wife of Prof. Knight Pryor, University of Louisville; William Lucas, former chairman; Mrs. Lucas; County Judge Horace M. Barker; Mrs. Elmer Dreyer; Warner Hambleton, vice-chairman; Henry Heuser, former chairman; Elmer J. Dreyer, chairman; and Marion Clower, treasurer.)

MEMBERS OF THE ASME SAN FRANCISCO SECTION LISTENING TO A TALK DURING A VISIT TO THE FRIDEN CALCULATING MACHINE COMPANY

Christmas Party at Louisville Section

Forty members and their wives enjoyed a delightful Christmas party on Dec. 19 at the Seelbach Hotel, Louisville, Ky. The party started with a cocktail hour, followed by a buffet supper. The program was a speech by County Judge Horace M. Barker who gave an insight into the workings of local government and urged participation by the engineering profession in civic development.

Meehanite Castings, Talk at Mid-Continent Section

On Nov. 20 at the Mayo Hotel, Tulsa, Okla., an audience of 80 heard a talk by Walter Illig on "Meehanite Castings and Their Application." Illustrating with a motion picture, Mr. Illig gave the history of meehanite cast iron, as well as the application of this material to modern engineering designs.

"There Is No Such Thing as the Cost of Raw Materials" was the subject at the Dec. 18 meeting in the junior ballroom of the Hotel Tulsa, Tulsa, Okla. The speaker was D. R. Cant, member ASME, and a member of the Section, who specializes in materials-handling equipment. Mr. Cant gave an interesting paper on this subject and its relation to material costs. He traced the materials-handling problem, from the origin of man to a modern shopping center, in a most interesting manner. A number of the members brought their wives and the women enjoyed the talk as much as the men.

Milwaukee Section Hears Talk on Research at BMI

F. B. Dahle was the speaker at the Dec. 10 meeting held at the Allis-Chalmers Manufacturing Company building, Milwaukee, Wis. His topic was "Production Research in the Battelle Memorial Institute." Mr. Dahle gave an interesting history of the Institute and its method of operation, and described specifically the operation of the research division which is in his charge. He discussed its place in the field of research and development, and various problems concerned with machine and product development. The talk was illustrated with slides. Seventy-five members and 50 guests enjoyed the lecture.

Oregon Section and AIEE Inspect Train of Tomorrow

The Section had as its guests on Dec. 5, members of the local section of the AIEE. The meeting was held in the marine room of the Multnomah Hotel, Portland, Ore., and over 200 were present. The program featured technical reports on "The Train of Tomorrow." A. Daniels, service manager and technical director of the Train of Tomorrow, gave a talk regarding the general mechanical and electrical aspects of the locomotive and four cars comprising the train. A question period was conducted. The answers to the many questions asked by the engineers were given by C. W. Perkins of the electromotive division; John Batsche of the Frigidaire division, Dayton, Ohio; and Fay Marvin of the Detroit Diesel Engine Division, all of the General Motors Corporation. The engineers were then conducted through this revolutionary new train.

The Engineer Discussed at Ontario Section

"The Engineer in the World of Tomorrow" was the subject on Dec. 11 at Hart House, University of Toronto, Toronto, Can. T. M. Medland, executive director, Associatian of Professional Engineers, Province of Ontario, was the speaker. The talk outlined the activities of engineers from early times up to the present, and discussed the opportunities and salaries which may be expected in the future. One hundred were present.

Peninsula Section Hears Talk on Rubber

"Evaluation of Rubber" was the topic at the Dec. 16 meeting in Grand Rapids, Mich. The speaker was J. D. Morron of the U. S. Rubber Company, and the talk was illustrated with slides and experiments covering natural and synthetic rubbers. Experiments included comparison of effect of temperature on properties. One experiment consisted of bouncing a fresh egg on a rubber pad.

Philadelphia Section Has Two Speakers

An audience of 70 heard a talk on "Development of South African Industry" by M. M. Loubser and W. M. Sheehan, Fellow ASME, at the Engineers' Club, Philadelphia, Pa., on Nov. 25. Dr. Loubser outlined the progress of South African Railways despite a shortage of water and in a country where most heavy equipment must be imported. Mr. Sheehan gave an interesting account of his recent visit to South Africa.

On Dec. 9 in the Edison Building, Philadelphia, Pa., E. C. Gegenheimer spoke on "The Future of Railroad Transportation," outlining the difficult financial plight of the railroads due to the fact that fare increases lagged far behind increases in operating costs. This was a joint meeting with the ASCE. Fifty-six were present.

Fly-Ash Problem Discussed by St. Louis Section

At the Park Plaza Hotel, St. Louis, Mo., an audience of 40 members head a talk entitled "Discussion of Fly-Ash Conditions and Proposed Modifications to the St. Louis Smoke Ordinance," led by G. V. Williamson, member ASME. Interesting slides were shown and an extensive discussion followed the talk which indicated the magnitude of the problem and the small amount that is known about the sources of fly ash and air pollution in general. It was agreed that considerable research should be done before an intelligent approach can be made to the problem.

Field Trip Feature of San Francisco Section Meeting

Thirty-eight members and 27 guests made a field trip to the Friden Calculating Machine Company's plant, San Leandro, Calif., on Nov. 20. Dunstan S. Gross and Harold Burlingame described many items about the plant and the manufacturing of the calculator. The plant is 13 years' old. Expansion has been rapid and production increased fivefold in the last three years. Parts fabrication, quantity production, and detail assembly on a scale seldom found in most manufacturing, made this field trip a most interesting one. The Friden Company entertained the group with an excellent steak dinner preceding the trip through their plant.

On Dec. 19 at the Faculty Club, University of California, Berkeley, Calif., 40 members and guests assembled to hear Robert Sibley, Fellow ASME, executive manager of the California Alumni Association, and George L. Sullivan, Fellow ASME, dean of engineering at the University of Santa Clara. Mr. Sibley traced the developments of atomic-energy research, cited fission-product uses in medicine, agriculture, metals inspection, and in the location of fossils within limestone deposits. With the promise of controlled atomic power, including the possibility of interplanetary travel, he summarized these applications to demonstrate that atomic energy already shows great promise for the good of mankind. It was his opinion that "all nations must come under a plan for full and complete harmonization of effort to control atomic energy for the good of mankind."

Dean Sullivan, discussing the influence of war developments on engineering education, explained that these proposals are not sound and cannot greatly change the fundamental engineering curricula or reduce the time required. He said that an important contribution was made in bringing about the realization that engineering education will make the future student completely conscious of his social responsibilities as an engineer. Engineering schools everywhere, he remarked, are making curricula revisions to provide instruction in the so-called sociohumanistic subjects in recognition of the engineer's social responsibilities.

Inspection Trip Taken by South Texas Section

An inspection trip through the Houston plants of the Sheffield Steel Corporation, Houston, Texas, was made by 49 members and 9 guests on Dec. 12. The trip covered open-hearth steelmaking facilities, and rolling mills, including blooming, merchant plate, structural rod, and wire mills. Dinner was served in the Company dining room, and was followed by a question-and-answer period.

Susquehanna Section Hears Latest on Electric Gages

"Electric Gages in Research and Industry" was the subject of a talk by Kenneth R. Geiser, General Electric Company, on Dec. 8, at Bierman's restaurant, York, Pa. The talk was a concise summary of the most recent developments and applications of electric gages. The basic principles of operation were described with commentary on the behavior and limitations of the various instruments. Mr. Geiser illustrated with slides and a demonstration. Forty-two were present.

Toledo Section Holds Two Meetings

On Oct. 23 at Greunke's cafeteria, Toledo, Ohio, 25 members heard Paul Gravelle, member ASME, production engineer, Toledo Edison Company, speak on "Central Power Station Trends." Mr. Gravelle discussed modern trends in the design of central power stations, in particular the new addition to the Acme Station of his company. The Babcock and Wilcox film "Power for American Sea Power," was shown, as well as slides to illustrate Mr. Gravelle's talk.

On Nov. 25 at Greunke's cafeteria, Toledo, Ohio, two speakers from the Libbey Glass Company, Toledo, were on the program. The first, Harold Schutz, chief engineer of his company, spoke on the history of Libbey glass and illustrated with a sound color movie entitled "Blowpipes." A display of Libbey products was shown to the audience of 30. Charles Webb, training director of the Libbey Company, spoke on the training of Libbey junior engineers.

Television, Subject at Waterbury Section

On Dec. 10 in the University Club rooms of the Hotel Elton, Waterbury, Conn., the Section was host to the Litchfield County Engineering Society for dinner and a program. The address was by Hugh W. Grandberry, sales engineer for the General Electric Company. His subject, "Television," began with the early mechanical-type scanning-disk methods and ended with the modern electronic-type methods. The various problems of relay-stations, image interference, and receiver installation and service were discussed and illustrated by means of motion pictures and slides. Seventy members and guests were present.

West Virginia Section Hears Talk on Transportation

"Our Growing Air Transportation" was the subject of a talk by Jennings Randolph at the Dec. 9 meeting in Charleston, W. Va. A dinner with 45 present preceded the program. The audience of 75 for the program heard Mr. Randolph trace the growth of transportation as it is connected with the growth of the United States—through waterways, railroads, highways, and finally air-transportation industry in this country, and outline the part it must play in maintaining the peace of the world.

Student Branches

University of Akron Branch

A business meeting was held on Dec. 11. Chairman Robert Harry announced the appointment of Donald Senuta as publicity chairman. Mr. Fleshman reported that a trip was being planned for the following week. Vice-chairman Roy Wiseman informed the members that slide rules would be available during the coming semester. Prof. Fred S. Griffin, member ASME, spoke briefly and convincingly on the need for group spirit. The program consisted of a talk by E. G. Reed, director of the Reed Laboratories. Mr. Reed spoke on the importance of creative thinking and its value in bringing to light the undiscovered laws of science.

University of Alabama Branch

A meeting was held on Oct. 22 in 210 Engineering Building. Chairman J. S. Wolanin announced this as an emergency meeting concerning the engineers' open house. Members were asked to contribute their time and energy to prepare for that special occasion. A short movie entitled "The Prophecies of Nostradamus," was shown.

The meeting on Nov. 3 had 31 members present. Chairman Wolanin announced the winning of the St. Pat Exhibition Cup. Professor Shenk, member ASME, honorary chairman, thanked all the members who took part in the engineers' open house, and showed the trophy which this branch had won. Members nominated for the membership drive committee were: Messrs. Ely, Gurnis, and Smith. A Movie "Design and Construction of Steam-Generating Plant" was shown after which a student paper was presented by Mr. Goldsmith who spoke on the general properties and commercial applications of butane.

At the Nov. 17 meeting, program chairman Feder announced that a special movie "Engineers' Approach to a Problem" would be seen before long. A loving-cup committee was established for judging the best student speaker of the year. Messrs. Smith, Patterson, and Harmon were elected to serve. Professor O'Brien, junior member ASME, gave a talk on life in Oak Ridge, Tenn., where he served during the late war.

University of Arizona Branch

A joint dinner meeting with the student branches of the ASCE, AIEE, and AIME, was held Dec. 4 in the Santa Rita Hotel, Tucson, Ariz, with 130 present. Guest speakers were Charles R. Kuzell, assistant general manager for Phelps Dodge Corporation, and Francis J. Riley of the law firm of Evans, Hull, Kitchell, Riley, and Jenks, of Phoenix, Ariz. The topic of the speakers was "Labor Relations." Mr. Kuzell urged the upperclassmen of the university studying mining and engineering, to study all forms of government and then decide to promote our own system in which the greatest opportunities are available under a free economy. He listed freedom of opportunity as a fifth freedom and one which really underlies the democratic system of government. Mr. Kuzell also told the students that engineers are good men to promote into labor-relations work. Labor relations, he claimed, is a greater and harder task than engineering, because the labor expert is dealing with people while the engineer is dealing with inanimate objects and problems.

On Dec. 18 in the Humanities Building, the guest speaker was J. P. Dods, formerly sales manager of the Summerill Tubing Company. His topic was "An Engineering Education as a Background to Industrial Sales." Mr. Dods explained the principles of good salesmanship, and said that as often sales are made to engineers, an engineering education is most important. To be a good salesman, he said, one must like selling. He further said that salesmanship is a good background for most jobs in nearly all the industries, while, on the other hand, experience in engineering is very important for salesmanship. Thirty-four were present.

California Institute of Technology Branch

At a joint meeting on Dec. 8 with the SAE student branch, in the Mechanical Engineering Building an audience of 30 heard H. B. Boller, junior member ASME, of Boller and Chivens, engineering firm, and a Caltech alumnus, speak on the problems encountered by a private engineering firm engaged in providing for its customers a variety of services ranging from drafting to engineering and design. Slides illustrating the variety of jobs handled were shown of a unique adjustable clamp used to regulate the flow of anesthetic for oral surgery, and of a complicated mechanism used to regulate accurately pump speed. Mr. Boller concluded his talk by answering questions.

Catholic University of America Branch

The meeting on Nov. 18, with 30 members and 2 guests present, featured a talk by William F. Dietz, representative of the Westinghouse Electric and Manufacturing Corporation, who spoke on "Opportunities in Sales and Management for Graduate Engineers." Mr. Dietz graciously answered questions from the floor pertaining to his talk. Two movies followed: the first, "Dielectric Welding," and the second, "Summer Storm."

Thirty-three members and 22 guests met on Dec. 16 to hear Carl W. Besserer, supervisor of design engineering in the Applied Physics Laboratory of Johns Hopkins University, speak on "Introduction to the Ramjet." Mr. Besserer discussed the subject with regard to design, performance, and operation. A series of slides on the subject accompanied the talk and questions were answered from the floor after the talk. Maurice E. Weschler, member ASME, head of the department of mechanical engineering at the University, was present.

Clarkson College of Technology Branch

Thirty members of the branch made a field trip to Utica and Rome, N. Y., on Nov. 21 and Nov. 22, respectively. Industrial plants visited were the steam and gas plant, Bassard Corporation, West End Brewery, and the Rome Cable Corporation.

Thomas Meehan, vice-president, presided at the Dec. 11 meeting of the branch. A contest, open to any student member and sponsored by the Lincoln Arc Welding Corporation, was announced.

Colorado A&M College Branch

On Nov. 3 in the mechanical-engineering building, 55 heard a talk on "Marine Engineering" by Jim Manzolillo, sophomore mechanical-engineering student at the College. The speaker, who has had five years' experience as a marine engineer, described the several types of marine power plants with which he has worked.

Fifty-six members and guests made an inspection trip on Nov. 17 through the Great Western Sugar Factory, Fort Collins, Colo. Ray Barmington, mechanical engineer engaged in sugar-beet machinery research at the Colorado Agricultural Experiment Station, described the sugar-refining process to the group.

PROF. J. D. SHAW (CENTER) ANSWERING QUESTIONS AFTER THE CORNELL STUDENT BRANCH MEETING OF DEC. 2. ALSO SHOWN ARE ROBERT HEATH (LEFT) AND WILLIAM STAMETS (RIGHT)

On Dec. 1 in the mechanical-engineering building the final meeting of the fall quarter was held with 59 present. A Babcock and Wilcox Company movie "Marine Boilers" was shown. The film illustrated the operation and construction of marine boilers built by Babcock and Wilcox Company for installation in destroyers.

Cornell University Branch

"The Building of the Golden Gate Bridge," a movie produced and distributed by the Bethlehem Steel Company, was shown to an audience of nearly 200 members and guests at Sibley Hall, on Nov. 13. The film showed many details in the construction of the famous bridge in a most exciting manner, and indicated the advantages of good engineering organization.

On Dec. 2 in Sibley Hall, before an audience of 55 members and 35 guests, Prof. John D. Shaw, assistant director of the Powder Metallurgy Laboratory at Stevens Institute of Technology, Hoboken, N. J., addressed the branch. His talk dealt with the field of powder metallurgy, covering briefly the methods and means of fabrication of powder-metal parts. The lecture was illustrated by a series of slides and a sound movie made in the laboratory at Stevens Institute. Professor Shaw provided a number of interesting metal parts to illustrate the diverse applications possible with powder metals. He pointed out the future possibilities and prospects for this relatively new field of engineering investigation.

Drexel Institute of Technology Branch

A meeting was held in the Student Building on Dec. 3. The following officers were elected: William Bayer, chairman; Philip McGrath, vice-chairman; Warren Jensen, recording secretary; Joseph Vasta, treasurer. The speakers were A. A. Holzbaur of the Sun Shipbuilding and Dry Dock Company; Mr. Brewster of Westinghouse Electric Corporation; and Mr. Cooper of the Metal and Thermit Corporation. Slides were shown on all phases of welding, including gas, thermit, forge, resistance, and electric arc. Thirty-five were present.

Duke University Branch

The meeting on Dec. 16 was opened by chairman J. E. Martin. After a business meeting, an excellent movie "Diesel, the Modern Power" was shown. This was a product of General Motors Company.

University of Idaho Branch

On Nov. 24 with 45 present, a film "Years of Progress" by the Chrysler Corporation was shown. Professor Hindle gave a report on the possibilities of a trip to the Trentwood Rolling Mills in Spokane, Wash. James Miller named a committee to clean up after the engineers' ball to be held in the Student Union Building. Richard Gordon called for volunteers to help his committee in making signs and completing the exhibit for the dance. Membership pins were given to new members.

University of Kansas Branch

Sixty members attended the Nov. 20 meeting in the Student Union. The vice-president, Stephen Hadley, spoke to the audience on "The Engineering Profession in Transition." He pointed out the need for engineers in various fields and gave the salary scales for engineers in the past and at the present time. His speech brought out the salary expectancy for engineers in the future with regard to education and experience. Joe Beeler, *Kansas Engineer* student editor, gave a talk incorporating the findings of a group of engineering students on a recent field trip to Wichita. He explained the duties and psychological make-up for research, design, manufacturing, sales, erection, and public-relations engineers, and the personality type for each kind of engineer. A volunteer committee was selected to begin work on a project for the engineering exposition to be held in April.

The meeting on Dec. 11 was opened by the president, John Sells. He introduced Miss Harriet Harlow, who provided vocal entertainment for the 50 engineers present. The guest speaker was B. J. George, lawyer-engineer, Kansas City Power and Light Company, whose subject was "Professional Attitudes and Ethics of Practicing Engineers." He explained that the engineer has a direct moral and legal responsibility to the public, and suggested that engineers should keep up to date on subjects of broad interest as well as in their own technical fields. He concluded with the plea that the engineering group insure their profession by active civic participation, and maintaining a highly proficient profession that will demand recognition.

Lehigh University Branch

On Dec. 11 in Packard Laboratory, the development, principle, and applications of the gas turbine were discussed by Dr. C. W. Smith, General Electric Company. Dr. Smith stated that much of the early development of gas turbines was done by the Germans. Here in America, he said, the principle had long been

INFORMAL DISCUSSION AT LEHIGH UNIVERSITY STUDENT BRANCH MEETING. C. W. SMITH, GUEST SPEAKER, IS SHOWN IN CENTER

known, but is could not be developed until materials which could resist high temperatures were obtainable. With the aid of blackboard sketches, the speaker explained the basic thermodynamics of the turbine. A question period followed, and subsequently a short business meeting was held. Seventy were present.

Michigan College of Min. & Tech. Branch

A regular meeting was held on Nov. 2 in the East Engineering Building auditorium on Nov. 2. Following a short business meeting, Edward Powlenko, a student member, described the different types of jet-aircraft engines and explained the principles of operation. The second speaker was Jack Horner who spoke on "Materials Handling." He discussed methods of deciding what type of equipment to use in a plant and described many different types and sizes of conveyers. The audience totaled 65.

Mississippi State College Branch

The meeting on Dec. 4 was opened by E. K. Strohan, chairman, with 40 present. The following officers were elected: W. A. Bartholomew, chairman; J. C. Cherry, vice-chairman; G. H. Cathcart, secretary-treasurer. At the conclusion of the business meeting C. H. Wilson, a student, gave a talk on the installing of boilers.

University of Missouri Branch

Chairman Paul Edson called the meeting on Dec. 10 to order, and explained the Engineering Undergraduate Award and Scholarship Program of the James F. Lincoln Arc Welding Foundation. Prof. Milo M. Bolstad, junior member ASME, honorary chairman, spoke on "The Student ASME Member After Graduation," in which he explained how junior membership in ASME can aid the young engineer in entering into the engineering and social life of the community in which he chooses to work. Professor Bolstad stressed in particular the need and responsibility for the young engineer, as a professional man, to enter into the whole life of his community. After the program the members of the student branch of AIEE were guests of the branch for a showing of the March of Time film "Atomic Power," a story of the development of interest and knowledge of the atom climaxed with the atomic bomb. Sixty-eight members and thirty-six visitors were present.

University of Nevada Branch

At the Nov. 10 meeting a program committee was elected as follows: P. Hanford, B. Hutton, and G. M. Cundiff. The publicity committee consists of D. Bevans and Wm. M. Sodja. Mr. Geroux of Reno, Nev , gave a talk on steam cars and demonstrated his Doble steam car. This was the last steam car to be built (1930). It is in very fine running condition at present. Mr. Geroux owns several steam cars but claims this to be the best one of various types.

University of North Dakota Branch

The meeting on Dec. 10 in Chandler Hall, was called to order by chairman Ray Will. Two Allis-Chalmers films, one on steam turbines and the other on surface condensers, were shown. Bill McDermott gave the rules concerning papers to be presented at the ASME convention and suggested that a trophy be given to the member presenting the paper from the branch. A motion was passed to allow a maximum of $8 for that prize.

Northwestern University Branch

A short business meeting with 23 members present, was held on Dec. 4 in room 4, Technical Building. James Carroll, chairman, called the meeting to order. By unanimous vote it was decided that in order to speed up business meetings, the formal procedure of making motions would be discontinued.

University of Oklahoma Branch

At the Nov. 12 meeting in the Engineering Auditorium, chairman Robert M. Wright announced that the mechanical-engineers' float in the homecoming parade won first prize in the organization division, and the prize was a full-color picture of the float mounted on a beautiful plaque. Prof. F. S. Roop, junior mem-

ASME STUDENT BRANCH OF THE UNIVERSITY OF OKLAHOMA ber ASME, honorary chairman, spoke on the awards offered by the James F. Lincoln Arc Welding Foundation. The speaker was Donald Turkington, assistant professor of mechanical engineering at the University. He spoke on the coefficients of heat transfer of the various materials used in building a house, and gave a practical problem of heating and cooling an average house. This problem showed the advantages of the use of a building insulation such as rock wool. By the use of charts, Mr. Turkington put over the subject of heat transfer in an excellent manner. Thirty-six were present.

The Dec. 3 meeting was called to order by Robert M. Wright. The members were feted by the new initiates of Pi Tau Sigma, National honorary mechanical-engineering fraternity. The president of the fraternity, Bill Forney, turned the program over to Henry Hoffman, the pledge-program chairman. The pledgees acted in a classroom skit on the order of a radio quiz. Entertainment was furnished by Miss Altman and Miss Mary Crawford. A talk was heard by Benjamin Schultz, assistant director of the University's physical plant, entitled "Tips to Graduating Engineers." Mr. Schultz said that the engineer has to face various problems such as job seniority, and the ability of men to work together, or to work at odds.

Oregon State College Branch

On Nov. 13 fifty members of the branch made an inspection tour of the Albany Plylock Company's plant, located in the near-by city of Albany, Ore. This company has one of the largest and most modern plywood factories in the Northwest. The group viewed the entire process from the fir logs in the mill pond to the finished plywood being loaded onto the freight cars. Of special interest were the presses which bond the wood and glue by the use of high-frequency heating. This heating of the glue is done without heating the wood. Also of interest was the huge lathe which peeled the thin sheets from the logs and various types of machines for patching knotholes and other imperfections in the thin sheets of veneer.

Polytechnic Institute of Brooklyn (Day) Branch

On Nov. 28 a group of 25 members of the branch visited the air-conditioning and heating plant of the General Electric Company in Bloomfield, N. J. The plant employs 3000 men, and specializes in domestic and commercial heating and air-conditioning equipment. After three hours spent in the plant the members felt that the time had been profitably used. Messrs. McLenegan and Newell, plant engineer arranged the trip. A standing invitation was given to branch students to revisit the plant.

South Dakota State College Branch

The first joint meeting of the season for the engineering college was sponsored by the branch on Dec. 4. A capacity crowd of approximately 300 engineers filled the Union Ballroom for the event. The principal guest and main speaker was A. F. Gettelman, General Electric Company applications engineer. Mr. Gettelman gave an exceedingly informative speech on jet propulsion and gas turbines, and also presented a General Electric movie on the subject, produced by the Walt Disney studios. H. R. McCannell, sales engineer from General Electric Company, assisted in the proceedings. Darrel Searles, president of the Student Engineer's Council, gave a short talk on the advantages of the training program put forth by the Engineers' Council for Professional Development. Following lunch, a technicolor film on aluminum was presented.

Stanford University Branch

I. M. White, member ASME, chief engineer of the Pelton Water Wheel Company, San Francisco, Calif., spoke on "The Grand Coulee Project—World's Largest," at the meeting on Dec. 2. The turbines for this project, the world's largest man-made structure, were manufactured by the Pelton Water Wheel Company in conjunction with The Byron Jackson Company. Mr. White gave a short geological history of the southeastern part of Washington in which the Grand Coulee is located, and pointed out the need for irrigation in those fertile lands. Slides were shown with the talk which covered the planning, development, and manufacture of the giant turbines, each rated at 65,000 hp. Thirty-six were present.

Stevens Institute of Technology Branch

On Dec. 11 in Jacobus Hall, 84 members heard William H. Larkin, member ASME, consulting engineer, give a talk on "Licensing Laws for Engineers." He covered the historical development of the necessity for professional licenses, and the way to go about getting them. Mr. Larkin said that it requires four years' experience after graduation from college before the final license is issued.

Syracuse University Branch

The second regular meeting of the term was held on Nov. 19 in the Alumni House, with 32 members and 5 guests present. The newly elected honorary chairman, Prof. George A. Henderson, member ASME, was introduced. Professor Henderson told of his experiences as honorary chairman of the ASME branch at Vanderbilt University. Chairman George Hammond then introduced Mr. Coolbaugh, project engineer for the Easy Washer Company, Syracuse, N. Y. Mr. Coolbaugh gave a very entertaining talk on the use of the "Strobatac" for determining operational vibrations and rotational velocities of normally inaccessible moving parts, with actual demonstrations of the Strobatac on a typical problem encountered in industry.

Virginia Polytechnic Institute Branch

A meeting was held on Nov. 25 in Building 362. The first part of the program was the showing of a film "Lubrication" made by the U. S. Bureau of Mines through the courtesy of the Sinclair Company. Prof. J. B. Jones, member ASME, introduced C. E. Pond, member ASME, and superintendent of motive power for the Norfolk and Western Railway. Mr. Pond gave an interesting and informative talk on locomotives, using a number of slides to illustrate it.

University of Washington Branch

On Nov. 25 in 317 Guggenheim Hall, a short talk was given by George Panek, senior student, on his experiences while touring through several industrial plants in the Middle West during the past summer. The featured speaker was Warren W. Philbrick, member ASME, instructor in mechanical engineering and research associate at the University Engineering Experiment Station. Mr. Philbrick's topic was "The Interview—Its Real Purpose." He stressed that the interview is a social conversation in which the interviewer attempts to discover the interviewee's personality and how it would fit into his company's program. All members present, numbering 50, expressed enthusiasm over a proposed series of discussions to be held this winter, reviewing the possibilities of engineering work in the Pacific Northwest, which Mr. Philbrick has offered to lead.

A Christmas party was held in the Faculty Club on Dec. 3, with 31 members and 35 guests present. At this time the student branch and senior branch members participate in a dinner. After the dinner, Otis F. Lamson, junior member ASME, of the Western Washington Section explained with the aid of slides the recent advancements in the field of tool engineering, and showed the latest automatic machines in display at the recent Chicago convention. A motion picture illustrating the tooling processes of the new type of internal grinding machines was also shown. A musical program and a short skit lampooning the life of the married engineering students completed the program.

Wayne University Branch

On the evening of Dec. 4 in the Green Room, Webster Hall, Fred J. Donald, chairman of the constitution committee, read the draft of the branch constitution as revised at the Nov. 14 meeting. After some discussion and a few revisions the constitution was ratified. Nominations for officers to be elected at the January meeting were accepted by William Margolin, chairman of the nominations committee. John E. DeWald and George Clark volunteered to head the inspection trip and membership committees, respectively. John E. DeWald, mechanical-engineering senior, spoke on the subject of "Die Design," illustrating his talk with blackboard drawings and models. Mr. DeWald was able to illustrate many actual problems encountered by the engineer in actual practice, as he is in the employ of the General Motors Corporation. Forty-six were present.

Worcester Polytechnic Institute Branch

On Nov. 13 a brief business meeting was held in which the application and dues of new members resulting from the membership drive, were accepted. The speaker was W. C. Roberts, project engineer, Bell Aircraft Corporation, who gave a talk on jet propulsion. This talk was a combination of general and technical information on the subject. Mr. Roberts described the working parts of all types of jet engines, including rockets, and showed how the transition from propeller-driven aircraft was not as revolutionary in principle as is generally supposed. He spoke on the turbojet engine and said it was the most successful one of the present engines, demonstrating the theory of its operation on the temperature-entropy diagram. He also showed the Bell Corporation film "Report on Jet Propulsion," illustrating the parts of the turbojet engine and its application to the jet fighter plane developed by his company. Fifty were present.

University of Wyoming Branch

On Nov. 21 in Engineering Hall, 48 were present. Prof. Eric J. Lindahl, member ASME, was elected to serve as honorary chairman for the current year. The secretary was instructed to prepare a letter of appreciation for Harry E. House who has been serving temporarily as honorary chairman. A film on oil-drilling activity, "10,000 Feet Deep," was shown, with a film on the 1946 National Air Race.

ASME Sections

Coming Meetings

Anthracite-Lehigh Valley: February 27. Scranton Chamber of Commerce Building, at 8 p.m. Subject: Engineering of Household Appliances, by Harry M. Strong, chief engineer, The Murray Corporation of America.

Atlanta: February 27. This meeting will be a dinner meeting to be held at 6:30 p.m. Subject: The Engineer's Opportunities, by E. G. Bailey, president, ASME, and vice-president, Babcock and Wilcox Company, New York, N. Y.

Baltimore: February 23. The Engineers Club, Baltimore, Md., at 8 p.m. Subject: Labor and Management Relations, by D. W. R. Morgan, general manager, South Philadelphia Works, Westinghouse Electric Corporation, Philadelphia, Pa.

Boston: February 17. Massachusetts Institute of Technology, Graduate House, Cambridge, Mass., at 8 p.m. Joint meeting with The American Welding Society. Subject and speaker to be announced.

Buffalo: February 11. Worthington Pump and Machinery Company; dinner at 6:45 p.m. Meeting at 7:45 p.m. Subjects: Diesel Engines, by V. H. Holm, assistant manager, sales division, Worthington Pump and Machinery Company. Compressors, by E. Murray, assistant manager, compressor sales division of the same company.

Central Indiana: February 20. Subject: Management, by William A. Hanley, vice-president in charge of engineering, Eli Lilly and Company, Indianapolis, Ind.

Cleveland: February 12. Cleveland Engineering Society rooms at 8 p.m. Subject: Mechanisms, by John W. May. Film: Steam Power for American Sea Power, by the Babcock and Wilcox Company.

Fairfield County: February 18. Dinner meeting at Hotel Barnum, Bridgeport, Conn., at 6:30 p.m. Subject: Cutting Tomorrow's Costs, by George O. Califford, technical director, Remington Arms Company, Bridgeport, Conn.

Hartford: February 17. City Club, Hartford, Conn., at 6:30 p.m. This will be a "ladies' night" meeting. Subject: Commercial and Domestic Food Sterilization, by Frank Yourga, chief of food-processing research, Hartford Empire Company, Hartford, Conn.

Kansas City: February 9. University Club at 6:30 p.m. Subject: Your Society and You, by Linn Helander, vice-president, ASME Region VIII; professor, Kansas State College, Manhattan, Kan.

Louisville: February 20. (Place of meeting to be announced.) This will be a joint meeting with the student branch of the University of Louisville at 8 p.m. Subject: Jet Propulsion—Bell Helicopter, by Charles L. Fay, director of flight research, Bell Aircraft Corporation, Buffalo, N. Y.

Ontario: February 12. Hart House, University of Toronto, at 7:30 p.m. Subject: Bikini—The Human Side, by Forrest Nagler, chief mechanical engineer, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

St. Joseph Valley: February 17. St. Joseph, Mich., at 8 p.m. A technical film about rubber will be presented by a representative of one of the large rubber companies.

South Texas: February 26. Houston Engineers' Club, Houston, Texas, at 8 p.m. Subject: Steam Turbines, by John R. Carison, Westinghouse Electric Corporation.

Syracuse: February 10. Technology Club of Syracuse at 6:15 p.m.; dinner meeting. Subject: Boiler Feedwater Treatment, by D. V. Shetland, superintendent of maintenance, Oswego Steam Station, Central N. Y. Power Corporation.

Waterbury: February 3. The University Club rooms. Subject: Electronics in Industry, by W. I. Bendz, engineering supervisor, Westinghouse Electric Corporation.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., which is under the joint management of the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to members and is operated on a co-operative nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrants whose notices are placed in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available to members of the co-operating societies at a subscription of $3.50 per quarter or $12 per annum, payable in advance.

New York	**Chicago**	**Detroit**	**San Francisco**
8 West 40th St.	**211 West Wacker Drive**	**109 Farnsworth Ave.**	**57 Post Street**

MEN AVAILABLE[1]

MECHANICAL ENGINEER with three and a half years' experience in development and liaison engineering in the fields of turbines, compressors, and internal-combustion engines. Desires employment in capacity of sales or development engineer. Me-262.

MECHANICAL ENGINEER, executive, 25 years' experience with successful record. Design, development, plant layout, and production of mechanical equipment or steam specialties. Supervision of construction or plant operation. Available as project or development engineer. Prefered location, Buffalo or Niagara frontier. Me-263.

JUNIOR MANUFACTURING EXECUTIVE, age 28. BS, industrial administration. Six years' progressive background, from machine and tool design to process-engineering supervision. Tau Beta Pi. Married; will locate anywhere, prefers Southwest. Me-264.

MECHANICAL ENGINEER, 25, graduate, married. Desires position in South America that demands initiative and ability. Two years as design and service engineer with bearing manufacturer. Two years in Navy in charge of high-pressure steam-power plant afloat. Me-265.

MECHANICAL ENGINEER, age 25, BSME, three and one-half years' wide experience in testing and research, large electrical concern. Prefers plant operation, construction, or project supervision in southern USA, Central, or South America. Me-266.

EXECUTIVE TRAINEE, age 23, industrial and mechanical-engineering graduate. Capable of working into administrative or sales-management position. Two years' experience industrial engineering, purchasing, sales, and estimating. Public-speaking class director. Me-267.

MECHANICAL ENGINEER, age 30, BSME. One and one-half years' in mechanical development and plant engineering in glass industry; three and one-half years' aircraft-product engineering; two years' varied experience. Desires responsible position leading to administration. Me-268.

PRODUCTION EXECUTIVE, age 47, mechanical graduate, licensed PE. Progressive-production specialist, good organizer; capable of directing engineering, product development, tool design, improving methods; high-precision manu-

(*ASME News continued on page 188*)

---

[1] All men listed hold some form of ASME membership.

YARWAY
H
L
LIQUID LEVEL
INDICATOR
SERIAL
UNIT
PRES.

The popularity of the Yarway Liquid Level Indicator as a dependable boiler room instrument for instant, accurate, eye-level readings of overhead water levels, has led to a demand for supplementary *remote* signal devices *operated from the indicator.*

The new Yarway Control Unit with its remote light or horn Hi-Lo Alarm Signals, now answers that demand.

These signals installed at one or more remote points where a check in water level is desirable, provide both high level and low level alarms, within the full operating range of the Yarway indicator.

Light alarms show red for high or low levels—green for normal level. Horn signal has two vibrating horns of different tones, or a single horn for both high and low levels.

For complete details on this latest addition to the Yarway line of dependable steam plant equipment, write for Bulletin WG-1822.

YARNALL-WARING COMPANY
108 Mermaid Avenue, Phila. 18, Pa.

NEW!

WITH YARWAY REMOTE BOILER WATER LEVEL INDICATORS...

AUDIBLE AND VISIBLE REMOTE SIGNAL ALARMS

YARWAY REMOTE HI-LO ALARM SIGNAL HORNS.

YAR
WAY
YAR
WAY
YAR
WAY

YARWAY REMOTE HI-LO ALARM SIGNAL LIGHT, SHOWING LOW LEVEL, NORMAL OPERATION AND HIGH LEVEL.

YARWAY REMOTE LIQUID LEVEL INDICATOR

facture; cost and operating control; incentive and labor relations. Excellent record. Desires permanent position. Me-269.

POSITIONS AVAILABLE

Production Engineer, 40–50, mechanical graduate with operating experience covering wood flooring, to plan layout, set up schedules, and be responsible for production of hardwood flooring. Salary, $4000–$5000 year. Location, Tennessee. Y-64.

Assistant Engineer, under 45, degree in civil or mechanical engineering preferred, with two years' experience in building, construction, designing, machinery, or refrigeration. Professional engineer's certificate in New York State helpful. Considerable amount of drafting. Should have ability to write orders and specifications. Must pass a rigid medical examination. $3640. New York metropolitan area. Y-78.

Staff Engineer, mechanical or chemical engineer with a minimum of 5 to 10 years' experience on plant design in the heavy-process industry. Knowledge of distillation and solvent recovery desirable. $6000–$10,000, Washington, D. C. Y-83.

Engineers. (*a*) Lubricating sales engineers, 23–27, single, mechanical graduates. Will be trained to serve as lubrication specialists to assist in marketing activities. Will serve as expert advisers on lubrication problems. Will go into industrial plants and advise the management concerning proper lubricants to use for various machines and such allied problems. (*b*) Terminal operating assistants, 23–27, single, mechanical graduates. Will be trained to serve as terminal operating assistants to store, package, and distribute petroleum products. Will supervise native staff and will operate and maintain terminal facilities. Three-year contracts. $3900 a year plus living allowances. (*a*) China; (*b*) China and India. Y-95.

Procurement Engineer, preferably with mechanical or electrical background with considerable experience on setting up a procurement organization and a general knowledge of electric, electronic, and government procurement. $8000–$10,000. New Mexico. Y-108.

Project Engineer, mechanical graduate preferred with master's degree, 35–45, with minimum of 5 years' experience in the design and development of mechanical features of scientific and industrial instruments. Salary open. Southern California. Y-113.

Chief Engineer, preferably mechanical, with from 10 to 20 years' experience in directing large engineering department with company engaged in the engineering and construction of industrial buildings, preferably heavy-process industry. $10,000–$12,000 plus bonus. Y-123(a).

Mechanical Engineer to design stoves, furnaces, boilers, and allied heating equipment. Should be familiar with production techniques and have considerable experience in production. Should know something regarding the fabrication of cast iron and steel, and have an interest in research and development. Considerable contact work, as well as direction of men engaged in engineering design. Salary open. Ohio. Y-150.

Industrial Advertiser, not over 35, mechanical or chemical graduate or equivalent, with experience in visualization, layout, and production of industrial (heavy equipment) advertising. Will handle all phases of industrial advertising, contacting engineering departments and sales departments, write copy, visualize and carry out production, and make up sales-promotion material. Salary open. New York, N. Y. Y-151.

Engineers. (*a*) Piping and power engineer, 28–45, mechanical graduate, with experience in piping design and installation, to investigate conditions that exist in power, steam, and manufacturing plants; take measurements necessary, make drawings of steam and other piping installations, and incorporate these changes when necessary. (*b*) Electrical design engineer, 25–45, electrical graduate, with hydroelectric experience desirable, but not necessary. Should know electrical design and installation. Will investigate conditions that exist in power, steam, and manufacturing plants; take measurements necessary, make drawing of electrical circuits, and incorporate these changes when necessary. $5000. New Hampshire. Y-152.

Squad Leader, with some mechanical-design experience, preferably in regard to valves and pneumatically controlled devices. Should be able to check drawings and patterns and have ability to organize his department to keep necessary records. Should have prewar experience with knowledge of production methods and shop practice. $3900–$4680 depending upon qualifications. Northern New Jersey. Y-160.

Shop Supervisor with experience in the operation of punch presses, forging hammers, bulldozers, upsetters, thread rollers, lathes, drill presses, and tapping machines, to take charge of hardware production. $5000 year. Maryland. Y-161.

Maintenance Supervisors, 30–45, mechanical graduates preferred, with 5 years' practical experience in maintenance work to supervise maintenance and installation of new equipment. $4000 plus, depending upon qualifications. New Hampshire. Y-172(b).

Mechanical Engineer, graduate, 30–40, with concrete-pile manufacturing and installation experience, to make surveys, prepare reports, and do general engineering covering prestressed concrete pipe. $6000–$8000. Temporarily Cuba; later Eastern U. S. Y-176.

Project Engineer, 30–40, mechanical or civil graduate, to analyze water and sewage-treatment projects, prepare specifications, select equipment, supervise layout, and attend to correspondence. $5000–$6000 year. New York, N. Y. Y-196(b).

General Manager, chemical or mechanical engineer, with process-industry experience, to supervise operations of soap and vegetable-oil plant. Knowledge of Spanish desirable. $6000 plus bonus. Colombia. Y-198.

Chief Development Engineer, 35–45, mechanical or electrical graduate. Should be good experienced administrator with ability to direct intelligently small group of engineers and test men, also model shop. Should be thoroughly experienced in design and development of small precision electromechanical products similar to fractional-horsepower motors, electric fans, and automotive electric control devices. Upstate New York. Y-209-D-3859.

Senior Engineers, mechanical graduates, with ability to supervise junior engineers and draftsmen carrying out design assignments on parts of machines or complete machines, to contribute ideas for the betterment of design of existing implements, to analyze manufacturing problems and recommend improvement, and to instill engineering ideas into practical design. Must have definite personality which would allow them to get along with farmers, dealers, engineers, and production people. Requirements are considerable design work in medium-size machines, preferably agricultural equipment, with at least 2 years' experience in a responsible position, preferably in an agricultural department. $5000. Iowa. R-4662-C.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Feb. 25, 1948, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

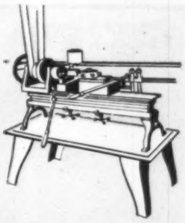
Re = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Fellow, Member, Associate, or Junior

Anix, Albert, Huntington Park, Calif.
Arden, Thomas T., Lynwood, Calif.
Atalla, Mohamed M., W. Lafayette, Ind.
Banerjee, R. N., Minneapolis, Minn.
Bereuter, Rudolf O., Trenton, N. J.
Bigelow, Charles Glenford, Chicago, Ill.
Bikle, W. E., New York, N. Y.
Blankfield, R. M., Iroquois Falls, Ont., Can.
Bond, Avery L., Los Alamos, N. Mex.
Borah, Kenneth, Wood River, Ill.
Bowersett, C. F., Laurel, Md.
Bowler, W. E., Philadelphia, Pa.
Brodersen, Edward M., Alhambra, Calif.
Brown, Harold L., Nyack, N. Y.
Brunn, G. A., Kansas City, Mo.
Buckley, Frank C., Philadelphia, Pa.
Butler, Charles Anthony, Edgewood, Md.
Carpenter, F. J., Fresno, Calif.
Carter, Willis Merle, Lexington, Ky.
Culbertson, R. P., Kokomo, Ind.
Daniels, Frank B., Baldwin, N. Y.

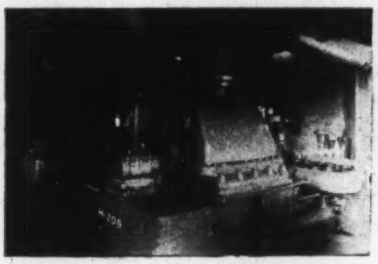
(*ASME News continued on page 190*)



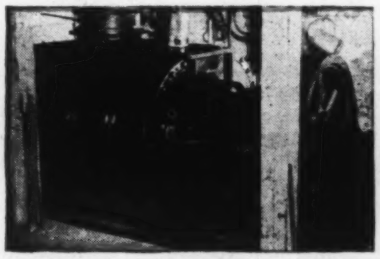
The first successful turret lathe and the first Roots Blower were built in the same year . . . 1854. We're not good because we're old, but old because we're good.

THE FIRST POUND OF IRON WAS MADE WITH AIR

(Photograph by courtesy of Inland Steel Company, from their motion picture "The Drama of Steel".)



Battery of five big R-C Centrifugal Multi-stage Boosters and Exhausters in a midwestern steel plant.



According to recollection of oldest employees at foundry where this R-C Rotary Positive Blower is installed, it's been giving dependable ,service for more than 38 years.

For the earliest melting of iron ore, air was supplied by crude, man-power bellows. Today, with a ton of pig iron requiring 2,500 pounds of air, high-capacity, power-driven blowers do the work.

This requires the greatest care in selecting blowers matched to the job. One reason for the frequent specification of Roots-Connersville equipment is our 94-year record for reliable performance.

Another important factor is R-C *dual-ability* to supply either Rotary Positive or Centrifugal units. We are unbiased in our recommendations of whichever type best meets the service demands. Roots-Connersville is the only blower builder giving you this *dual choice.*

For large capacities or for small, built-in applications, as low as 5 CFM, consult R-C *dual-ability* for your blower needs.

ROOTS-CONNERSVILLE BLOWER CORPORATION
802 Michigan Avenue, Connersville, Indiana

ROOTS-CONNERSVILLE
ROTARY CENTRIFUGAL

BLOWER BUILDERS R-C SINCE 1854

BLOWERS · EXHAUSTERS · BOOSTERS · LIQUID AND VACUUM PUMPS · METERS · INERT GAS GENERATORS

* * ONE OF THE DRESSER INDUSTRIES * *

Danner, William J., Indianapolis, Ind. (Rt)
Dykman, Milton, Rochester, N. Y.
Ericksen, Arndt Francke, Glen Ellyn, Ill.
Essen, Donald F., St. Louis, Mo.
Fisher, Harmon F., Sunnyvale, Calif. (Rt)
Fox, Augustus H., Schenectady, N. Y.
Foye, Homer J., Seattle, Wash.
Freese, Charles E., Scotia, N. Y.
Fulkerson, Archie P., Louisville, Ky.
Funk, Edward Ross, Wooster, Ohio
Gaetani, Charles, Bronx, N. Y.
Gass, Karl W., Pittsburgh, Pa.
Gibson, Christian D., Greene, N. Y.
Gillings, Andrew Joseph, South Bound Brook, N. J.
Gooch, Peter W., Montreal, Que., Can.
Greensite, Arthur, Bronx, N. Y.
Grim, Kenneth Holmes, Baltimore, Md.
Gross, Nicol, Cambridge, England
Gruitch, Jerry M., New York, N. Y.
Hahl, Robert G., Snyder, N. Y.
Hanlon, Raymond T., Chicago, Ill.
Herbert, Wilbur F., Montclair, N. J.
Hermann, Harold N., Cincinnati, Ohio
Hicken, Frank Ludwig, Kansas City, Mo.
Hoch, Harold S., Baltimore, Md.
Hoey, John Edward, Cincinnati, Ohio
Holmberg, Gilbert I., Jersey City, N. J.
Jarmy, Howard I., Chicago, Ill.
Jarvi, Ray Victor, College Station, Texas
Jenkins, Donald R., Easton, Pa.
Johnson, William A., Ecclesall, Sheffield, England
Kammel, Abdel Malek, Suez, Egypt
Karp, Ben, New York, N. Y.
Kelvy, George M., Philadelphia, Pa.
Kenny, Brian M., Brantford Ont., Can.
King, Joseph A., Union, N. J.
Kircher, Ralph N., West Bend, Wis.
Klinck, Ronald Woodard, Vancouver, B. C., Can.
Kuhn, Raymond W., Jeannette, Pa.
Larson, Arthur L., Wilmington, Del.
Long, John J., Guilford, Conn.
Lovell, William S., Savannah, Ga.
Lyngstad, A. E., Hollidays Cove, W. Va.
Macks, E. Fred, Lakewood, Ohio
Mangan, John Leo, Lynn, Mass.
Martin, Alan R., New York, N. Y.
Martin, Robert J., Alliance, Ohio
Marzoli, Angelo, Palazzolo Oglio (Brescia), Italy
Maxa, Jerry Frank, Baltimore, Md.
McGowan, Thomas J., Kansas City, Mo. (Rt & T)
McLain, Henry Earle, Wilmington, Del. (Rt & T)
Merriam, Paul A., Edgewood, R. I. (Rt)
Miller, R. H. P., Madison, Wis.
Mitchell, W. G., Aurora, Ill.
Montgomery, L. C., Kansas City, Mo.
Mooney, Richard W., St. Paul, Minn. (Rt & T)
Mosshart, Crockett, Detroit, Mich.
Mummert, Harold Byron, Fort Collins, Colo. (Rt & T)
Neustrom, Robert T., Kansas City, Kan.
Nichols, John B., Ballston Spa, N. Y.
O'Connell, William B., Chicago, Ill.
Osborn, Kenneth R., Haddonfield, N. J.
Overby, Eugene H., Savannah, Ga.
Plumpton, Mark W., Ealing, London W. S., England
Quinn, Donald Augustine, Medford, Mass.
Ragsdale, Robert, Jr., Los Angeles, Calif.
Rao, Chittimoor Jagannadh, Bezwada, India
Renzo, Peter Conrad, Teaneck, N. J.
Rogers, H. M., Jr., Spartanburg, S. C.
Rowe, L. H., Chicago, Ill.
Russell, Joan M., Buffalo, N. Y.
Scanlan, Robert H., Troy, N. Y.
Scott, James C., Long Branch, Ont., Can.
Singer, Norman, Bronx, N. Y.
Slater, W. F., Huntington Park, Calif.
Smith, Harold A., Indianapolis, Ind.
Snider, Andrew Jackson, 3rd, New York, N. Y.
Soissa, John A., Kenilworth, Ill.
Spaulding, Layton E., Naugatuck, Conn.
Spreng, Warren M., Ashland, Ohio
Stamm, F. L., South Gate, Calif.
Swinney, Robert L., Glencoe, Ill.
Tawdul, Adam J., Long Island City, N. Y.
Thomas, John A., Jr., Berkeley, Calif. (Rt & T)
Tyrrell, Francis T., Grand Rapids, Mich.
Vice, Charles L., Los Angles, Calif.
Waite, W. W., New York, N. Y.
Way, Robert C., Columbus, Ohio
Wheelahan, E. J., New Orleans, La.
Willard, W. R., San Mateo, Calif.
Williams, F. D. M., Nobel, Ont., Can.
Wirth, Henry John, Jr., Freeport, L. I. N. Y.
Woodson, Thomas T., Bridgeport, Conn.
Zink, D. D., Dallas, Texas

CHANGE IN GRADING

Transfers to Fellow

Weschler, Maurice E., Chevy Chase, Md.
Willard, John A., New York, N. Y.

Transfers to Member

Amrine, Harold T., Lafayette, Ind.
Austin, Hoyt, Barcelona, Venezuela
Brown, Harwood I., New Orleans, La.
Clarke, Charles W., Los Angeles, Calif.
Dooley, James L., Venice, Calif.
Falk, Martin C., Pittsburgh, Pa.
Finch, Roger B., Cambridge, Mass.
Giles, Charlie M., Seattle, Wash.
Hess, Robert G., Watertown, N. Y.
Kirkby, Norman O., Elmhurst, Ill.
Kissick, Joseph, Jr., White Plains, N. Y.
Kramer, Bernard L., Albany, N. Y.
McLarney, William J., Berwyn, Md.
Moulton, Rexford, Lyme, N. H.
Nelden, Richard M., Detroit, Mich.
Prosser, Robert G., Red Wing, Minn.
Rexford, Robert Stanley, Moline, Ill.
Rumfelt, Henry F. C., Alexandria, Va.
Schmoyer, Richard L., Fullerton, Pa.
Schubert, Dale L., Tacoma, Wash.
Shoudy, Charles A., Charleston, S. C.
Sudduth, H. Norton, Watertown, N. Y.
Zirin, Maxwell, Brooklyn, N. Y.

Transfer from Student Member to Junior 45

DEMA Elects 1948 Officers

GORDON LEFEBVRE, president, Cooper-Bessemer, Corporation, Mt. Vernon, Ohio, was elected the new president of Diesel Engine Manufacturers Association, at the Association's annual meeting, Dec. 10, 1947, Chicago, Ill.

Otto H. Fischer, president, The Union Diesel Engine Company, and L. W. Metzger, vice-president, The Baldwin Locomotive Works, were elected new vice-presidents.

Robert H. Morse, Jr., vice-president, Fairbanks, Morse and Company, was re-elected treasurer, and Harvey T. Hill was reappointed executive director.

Elected to serve two years on the board of directors were: George W. Codrington, member ASME, vice-president, General Motors Corporation and general manager of Cleveland Diesel Engine Division; E. J. Schwanhausser, member ASME, vice-president of Worthington Pump and Machinery Corporation; A. W. McKinney, vice-president, The National Supply Company; Mr. Morse, and Mr. Metzger.

Necrology

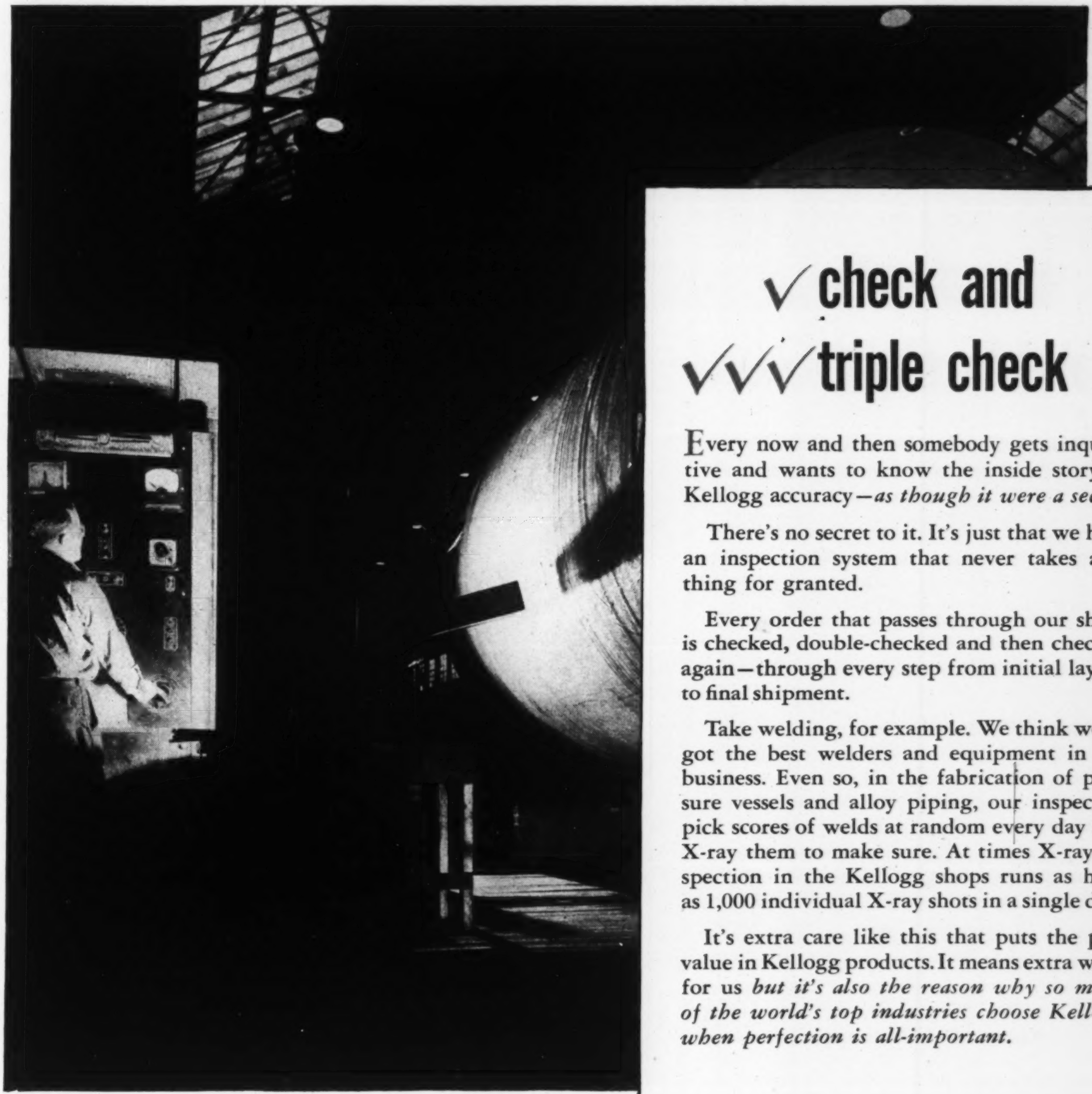
THE deaths of the following members have recently been reported to headquarters:

Catland, Raymond O., November 11, 1947
Day, Ralph R., November 1, 1947
Fitze, Maurice E., November 19, 1947
Goodrich, Thomas M., April 27, 1947
Happel, Albert W., December 1, 1947
Huston, Frederick P., December 29, 1947
Kraut, Hans B., December 26, 1947
Ludwick, William L., December 9, 1947
Martin, Frank W., October 1, 1947
McCully, Harry M., November 29, 1947
Moen, Levi W., May 8, 1947
Mylroie, John E., November 22, 1947
Rilliet, Jean L., October 3, 1947
Robbson, A. M., November 15, 1947
Schaum, Otto W., December 8, 1947
Sedgwick, Earl H., November 27, 1947

ASME Transactions for January, 1948

THE January, 1948, issue of Transactions of the ASME contains the following papers:

TECHNICAL PAPERS
- High-Temperature Disk-Forging Developments for Aircraft Gas Turbines, by L. B. Fonda
- Heat Transfer by Free Convection From Heated Vertical Surfaces to Liquids, by Y. S. Touloukian, G. A. Hawkins, and M. Jakob
- Review of Data on Dynamic Viscosity of Water and Superheated Steam, by G. A. Hawkins, W. L. Sibbitt, and H. L. Solberg
- Temperature Distribution in Some Simple Bodies Developing or Absorbing Heat at a Linear Function of Temperature, by Max Jakob
- Research Work on Rail Sections, by Walter Leaf
- Recent Developments Concerning the Properties of Cast Steels, by C. W. Briggs
- Temporary Installation of Shasta Turbines at Grand Coulee, by H. H. Sloane
- Applications of Mechanical Cascade Control Systems, by J. N. Swarr



✓ check and ✓✓✓ triple check

Every now and then somebody gets inquisitive and wants to know the inside story of Kellogg accuracy—*as though it were a secret.*

There's no secret to it. It's just that we have an inspection system that never takes anything for granted.

Every order that passes through our shops is checked, double-checked and then checked again—through every step from initial layout to final shipment.

Take welding, for example. We think we've got the best welders and equipment in the business. Even so, in the fabrication of pressure vessels and alloy piping, our inspectors pick scores of welds at random every day and X-ray them to make sure. At times X-ray inspection in the Kellogg shops runs as high as 1,000 individual X-ray shots in a single day!

It's extra care like this that puts the plus value in Kellogg products. It means extra work for us *but it's also the reason why so many of the world's top industries choose Kellogg when perfection is all-important.*

FABRICATED PRODUCTS DIVISION

THE M. W. KELLOGG COMPANY

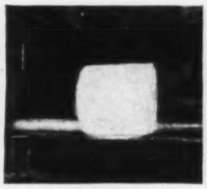
A SUBSIDIARY OF PULLMAN INC.

NEW YORK • JERSEY CITY • BUFFALO • LOS ANGELES
TULSA • HOUSTON • TORONTO • LONDON • PARIS

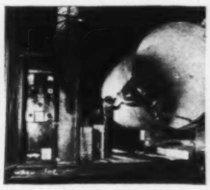
VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.

Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.

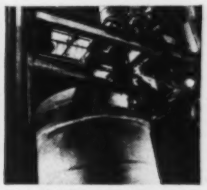


Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.



Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

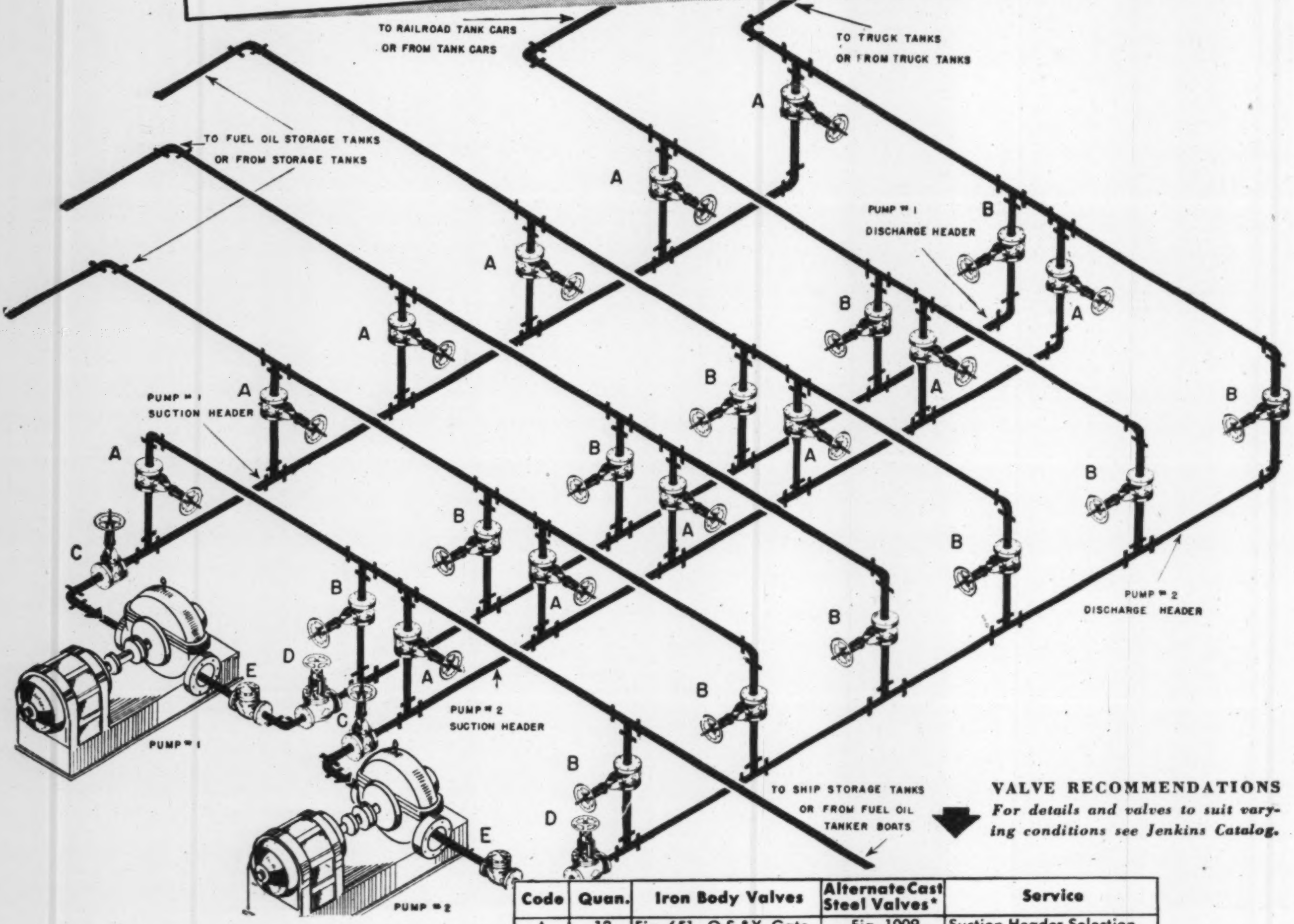
On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.



Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.

Jenkins PRACTICAL PIPING LAYOUTS 28

How to plan BULK STORAGE STATION PUMP HOUSE CONNECTIONS


TO RAILROAD TANK CARS
OR FROM TANK CARS
TO TRUCK TANKS
OR FROM TRUCK TANKS
TO FUEL OIL STORAGE TANKS
OR FROM STORAGE TANKS
PUMP #1
DISCHARGE HEADER
PUMP #1
SUCTION HEADER
PUMP #2
DISCHARGE HEADER
PUMP #2
SUCTION HEADER
TO SHIP STORAGE TANKS
OR FROM FUEL OIL
TANKER BOATS
PUMP #1
PUMP #2
A
B
C
D
E

VALVE RECOMMENDATIONS
For details and valves to suit varying conditions see Jenkins Catalog.

Code	Quan.	Iron Body Valves	Alternate Cast Steel Valves*	Service
A	12	Fig. 651—O.S.&Y. Gate	Fig. 1009	Suction Header Selection
B	12	Fig. 651—O.S.&Y. Gate	Fig. 1009	Discharge Header Selection
C	2	Fig. 651—O.S.&Y. Gate	Fig. 1009	Pump Suction Shutdown
D	2	Fig. 613—O.S.&Y. Globe	Fig. 1040	Pump Discharge Control
E	2	Fig. 624 Swing Check	Fig. 1025	Pump Discharge Check

**These valves also furnished with welding ends.*

Bulk stations for the storage of gas, fuel oils, or other liquid fuels are usually laid out with either a single or double line system. In the single line system, all tanks containing one grade of oil are connected to the pump house by a common line. In the double line system illustrated here, each storage tank is connected to the pump house by an individual line.

The pump house connections for the two systems differ only in the number of pump house tie-ins. The double line system has more connections which allow for maximum handling efficiency. In addition to the lines from the storage tanks, the pump suction and discharge headers must be connected to the pipe lines from tankers, tank cars, and truck tanks.

The duplicate pump installation provides emergency standby service and also allows for two separate and simultaneous pumping operations. Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation. Copies of Layout No. 28, enlarged, with additional information, will be sent on request. Mail coupon.

A CHOICE OF OVER 500 VALVES

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the Jenkins Catalog. It's your best assurance of *lowest cost in the long run.*

Jenkins Bros., 80 White St., New York 13; Bridgeport, Conn.; Atlanta; Boston; Philadelphia; Chicago; San Francisco. Jenkins Bros., Ltd., Montreal.

LOOK FOR THIS JENKINS **DIAMOND MARK**
Since *Jenkins Bros* **1864**

JENKINS VALVES

For every Industrial, Engineering, Marine, Plumbing-Heating Service . . . in Bronze, Iron, Cast Steel and Corrosion-resisting Alloys . . . 125 to 600 lbs. pressure.

Sold Through Reliable Industrial Distributors Everywhere

JENKINS BROS., 80 White St., New York 13, N. Y.
Please send me a reprint of Piping Layout No. 28

Name ....
Company ....
Address ....
....

• Keep Informed . . .

Announcements in this section are about
current advertisers in MECHANICAL ENGINEERING
and A.S.M.E. MECHANICAL CATALOG.

*All items are supplied by these advertisers
and the section is restricted to them.*

• NEW EQUIPMENT
• BUSINESS CHANGES
• LATEST CATALOGS

Available literature or information may be secured by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as a source.

• *NEW EQUIPMENT*

"Di-Acro" Notcher

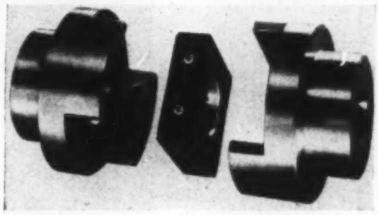
The "Di-Acro" Line of Die-Less Duplicating Equipment has just been expanded by the addition of an entirely new product known as the "Di-Acro" Notcher.

This new product is an excellent companion unit for other "Di-Acro" Precision Machines.

Complete information covering the new "Di-Acro" Notcher is contained in the 40-page Di-Acro Catalog and this will be mailed gratis to readers upon request. Address a line to O'Neil-Irwin Mfg. Co., Lake City, Minn.

Improved Flexible Coupling

A recent design improvement has increased the wearability of the American Flexible Coupling as much as 30 per cent, according to an announcement made by the manufacturer on the basis of tests.

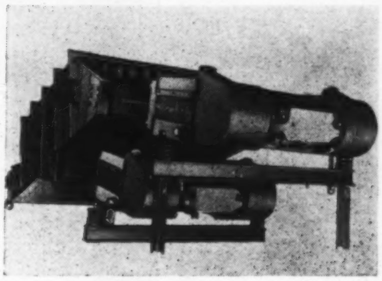


The only part that absorbs wear in these couplings is the center member or block which has a free sliding action between the two jaw flanges of the coupling. This center member is faced with bearing strips which are the points of contact with the jaw flanges. The center block was recently improved so that the bearing strips now slide upon the center block to which they are secured. This greatly reduces the friction which results between the bearing strips and the flanges as the coupling rotates.

The American Flexible Coupling is based on the Oldham principle. Each of two jaw flanges, mounted on the shafts, engages opposite parallel surfaces of a square center member, the engaged surfaces of each being at right angles. The center member slides between the two integral jaws of each jaw flange in directions relatively at right angles as the whole coupling rotates, transmitting the torque.

This coupling obtains its flexibility through design as compared with the conventional method of obtaining flexibility through the flexing of a resilient material. The purpose of the American Coupling is to permit shafts to operate misaligned without transmitting reactionary stresses which may increase the bearing temperature and accelerate the rate of bearing wear in the prime mover or driven machine. Manufactured by the American Flexible Coupling Co., Erie, Pa.

Heavy Duty Vibratory Grizzly Feeder



Specially designed for the large capacity separation of crusher feeds the F-55 double magnet, heavy duty electric vibratory grizzly feeder illustrated is the latest addition to the "Syntron" line of Vibratory Grizzly Feeders which already include the models F-33, F-44 and F-45.

These grizzlies are available in different sizes and styles, either single or double magnet, with the magnets mounted above the deck or below, all featuring the variable control of the rate of feed and with either full or partial grizzly decks.

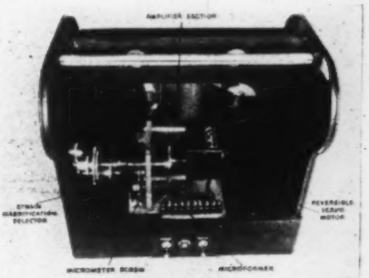
Operation is from 220 volt, or 440 volt A.C. The small models, the F-1, F-21, and F-22 can also be operated from 110 volt, A.C.

For complete information write to Syntron Co., 850 Lexington, Homer City, Pa.

Microformer
Strain Recording System

Newly added to Baldwin testing equipment is the Type M stress-strain recorder controlled by two Microformers (variable miniature transformers) which are built into strain follower and recorder mechanisms. Principal application is in recording strains or deformation in test specimens subjected to tension, compression or flexure in Baldwin and other Universal testing machines.

In operation, changing deformation in the specimen actuates the movable core of the strain-follower Microformer, which changes its output and unbalances an electrical circuit that includes the similar Microformer in the recorder. The resulting electrical impulse is amplified to drive a servo motor, which moves the core of the recorder Microformer, thus rebalancing the electrical circuit and rotates the recorder drum in proportion to specimen deformation.

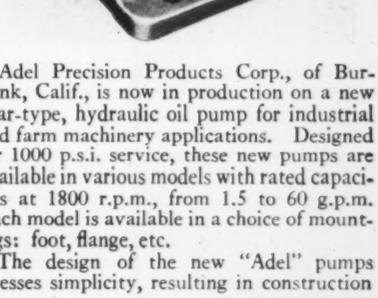


Corresponding values of applied load are recorded by movement of the stylus parallel to the axis of the recorder drum. The stylus is actuated mechanically by the testing machine load indicator.

The direction of rotation of the recorder drum changes automatically with change in direction of deformation in the specimen. This facilitates the recording of tests in which specimens are loaded and unloaded. The performance of the Microformer-controlled strain-recording element of the recorder is consistently accurate over a wide range of testing speeds.

Although the Microformer system is being used chiefly with strain-recording devices designed to magnify strain up to 1000 times or more, it is also adaptable for recording almost any pair of variables by using some index of each variable to actuate a Microformer.

Adel's New Hydraulic Oil Pump



Adel Precision Products Corp., of Burbank, Calif., is now in production on a new gear-type, hydraulic oil pump for industrial and farm machinery applications. Designed for 1000 p.s.i. service, these new pumps are available in various models with rated capacities at 1800 r.p.m., from 1.5 to 60 g.p.m. Each model is available in a choice of mountings: foot, flange, etc.

The design of the new "Adel" pumps stresses simplicity, resulting in construction

Continued on Page 42

DROP FORGINGS

Let us quote on your requirements.

Producers of quality forgings for over twenty-five years.

Baldt
ANCHOR, CHAIN & FORGE DIVISION
of
The Boston Metals Company
CHESTER, PA.

A Plus Value
in any product

STAINLESS STEEL
FLOATS

If a float is an integral part of your product, that product can't have a finer recommendation for quality than to say that it is equipped with stainless steel floats by Chicago Float Works. These high quality floats give longer, trouble-free service under higher pressures and temperatures. Their extreme strength and corrosion resistance go a long way toward building endurance and dependability into your product.

Write for catalog containing: Complete line of standard types (Stainless, Monel, Copper, Brass, Aluminum and Steel), sizes, shapes, and connections; buoyancy calculations; details of Chicago Float Works' complete recommendation service.

CHICAGO FLOAT WORKS, INC.
2328 S. Western Ave.
Chicago 8, Illinois

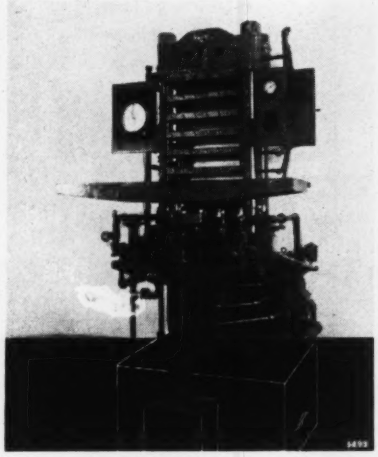
features which offer lower initial cost, longer service and less maintenance care. Precision-machined, spur-type gears assure highest pumping efficiency. The cutaway view of the pump illustrates the special seal used on the drive shaft. This seal assures positive leakproof action and eliminates packing difficulties. A ball bearing on the drive shaft absorbs all thrust and radial loads imposed by the drive. Alloy iron housings are used throughout, with hardened steel gears and shafts which provide the best wear characteristics.

One of the outstanding features of the new Adel pump design is the method of keying the gears to the shafts. A unique ball drive permits gears to float endwise on shafts. This prevents any thrust loads from being transferred from the shaft to the gears or end plates. It also insures perfect alignment of the gears at all times.

Another special feature is the unusual method of lubricating the internal working parts of the pump. Fluid trapped in the pumping gears is utilized to pressure-lubricate shafts, bushings and bearings. See illustration for schematic diagram of flow. This pressure lubrication system permits the use of lower cost journal bearings for the shafts. The pumps are internally drained. No extra pumping is required.

Automatic Controls Feature Farrel-Birmingham Molding Press

This 24" × 24" six-opening, hydraulic compression press, designed by Farrel-Birmingham for molding rubber and plastics articles, has several special features that contribute to unusually fast and precisely controlled performance, plus economy of operation and durability of construction.



Initial pressure is 2000 lbs. psi which gives a plate pressure of 614 lbs. psi, or a total capacity of 177 tons, with maximum deflection over the platen area of .005".

The motor-driven oil pressure pump is a radial piston duplex type, equipped with cooler and filter and mounted on a fabricated-steel oil tank on the floor back of the press. Its capacity gives the following operating speeds: Closing 59" per minute, pressing 3" per minute, lift table rise 231" per minute. Lift table descent is by gravity. Ram operation is by a four-way valve equipped with hand lever and the lift table is operated by separate hand lever valve.

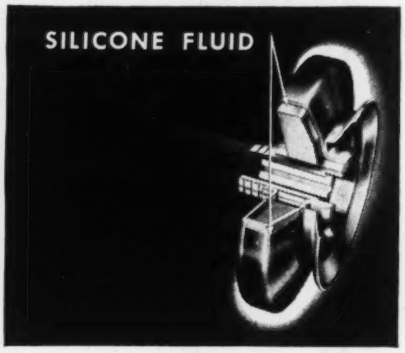
Automatic controls include the blow-down timer which gives intermittent release of condensation from the platens. Next to this timer on the right panel is the pressure gauge which has start and stop buttons beneath it. By adjustment of the pump the platen pres-

Silicone News
DC
DOW CORNING
SILICONES

Men versus Inertia

Your best men fight inertia. They are never satisfied with things as they are. They know that there's always a better way, and that someone else will find it if they don't. They know, as you do, that major improvements in design and performance result from the use of new and different materials.

That's why they are so eager to find out about Dow Corning Silicone Products. These new and basically different materials make the "impossible" practical. Here's a good example.



COURTESY HOUDE ENGINEERING DIVISION, HOUDAILLE HERSHEY CORPORATION

High viscosity DC Silicone Fluid makes possible this simple, durable torsional vibration damper for automobile and diesel crankshafts. Inner flywheel, separated by a film of DC Silicone Fluid from housing attached to end of crankshaft, tends to rotate at constant speed. Any change in speed is damped by shear resistance of silicone film.

Operation of this device depends upon the well-established principle of viscous damping. That principle has been of limited use, however, because there were no fluids that did not thin out at high temperatures, thicken at low temperatures, or break down under mechanical shearing.

But our silicone fluids do not behave the way other fluids do. They have a singularly constant viscosity at both high and low temperatures, and they don't break down under constant shearing. Farsighted engineers seized upon these unique properties to make viscous damping a practical reality.

Unique properties such as these distinguish all Dow Corning Silicone Products—resins, varnishes, fluids, lubricants, and Silastic.* You, or someone in your plant, will want to know more about the DC Silicones.

Our engineers have had over four years of experience in producing them on a commercial scale and in adapting them to many lines of business. Telephone one of our offices or write for Catalog No. C1-1.

*TRADEMARK BENDIX AVIATION CORPORATION

DOW CORNING CORPORATION
MIDLAND, MICHIGAN
New York • Chicago • Cleveland • Los Angeles
In Canada: Fiberglas Canada Ltd., Toronto
In England: Albright and Wilson, Ltd., London

Dow Corning
FIRST IN SILICONES

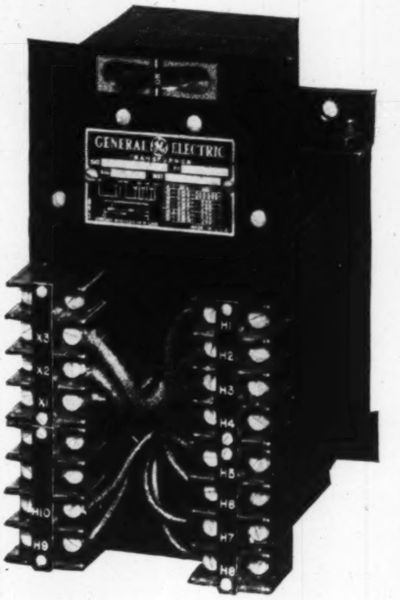
sure may be set at any point from zero to maximum. On the left panel is the temperature control which is connected to a condensation chamber. This device automatically maintains even heat in the platens and has removable charts for continuous temperature recording.

In overall construction, the press is extremely sturdy. Top and follower crossheads are of cast Meehanite metal and the bottom cross-head integral with the cylinder is made of steel. The platens are of rolled, silicon killed steel, smooth-tool finished on the working surfaces, and accurately drilled, tapped and plugged for steam circulation.

This is one of the most recent designs in the complete line of hydraulic presses built by Farrel-Birmingham for a wide variety of applications. These range in size from 12″ square for laboratory work and small production to huge hydraulic presses as large as $36^1/_2$′ in length.

New Line of Machine Tool Transformers

A complete new line of machine tool transformers designed as a result of an extensive company survey among the manufacturers of machine tools, has been announced by the Specialty Transformer Division of the General Electric Co.

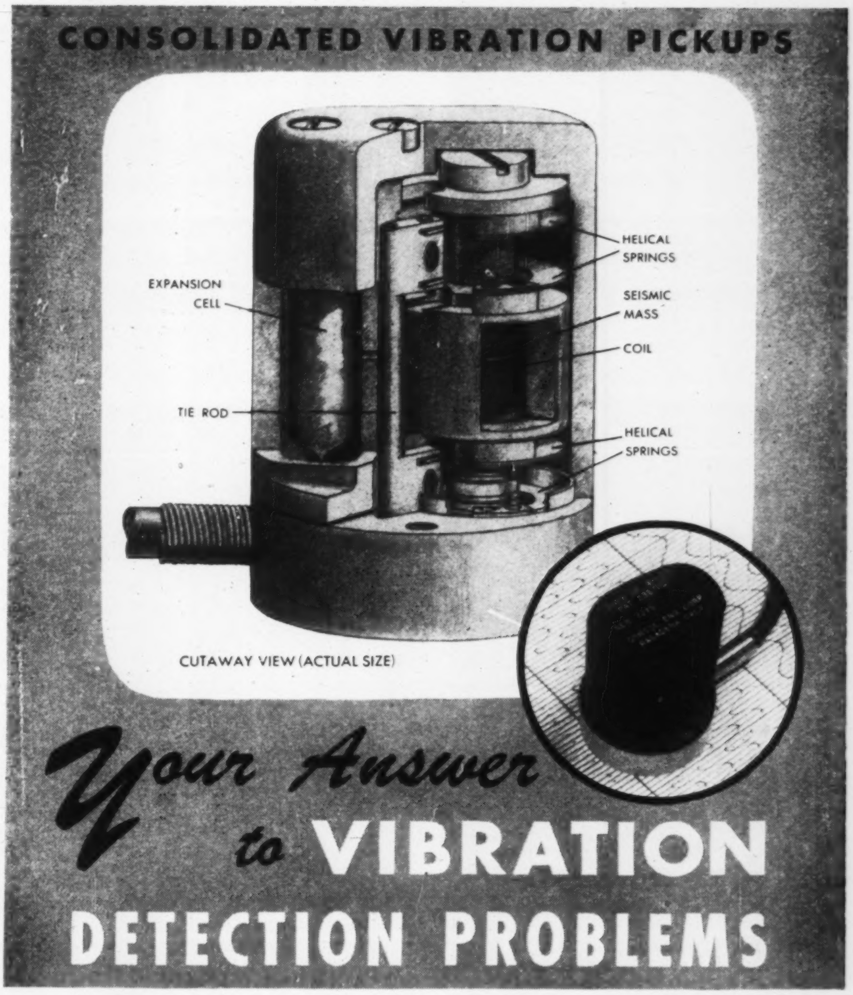


A large segment of domestic machine tool transformer requirements is provided for by ten ratings ranging in size from .075 to 3 kva for use on 60 cycle circuits of either 220 or 440 volts.

For 25-cycle applications these transformers are listed in four standard sizes ranging from .150 to .500 kva. These units have primary voltage taps for 220, 440, and 550 volts. To complete the line, an all-purpose group of transformers rated for both 50- and 60-cycle supply circuits is provided. The primary is equipped with 8 voltage taps ranging from 208 to 550 volts. They have standard 110-volt secondaries with 92-volt taps for operation of 60-cycle relays on 50-cycle circuits. These versatile units will reduce stocking problems and meet requirements of most foreign as well as unusual domestic applications.

Installation time and panel space are saved by the functional compact design of these transformers which provides convenient control panel mounting of practical built-

Continued on Page 44

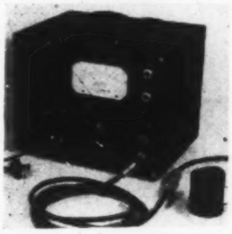

CONSOLIDATED VIBRATION PICKUPS
HELICAL SPRINGS
EXPANSION CELL
SEISMIC MASS
COIL
TIE ROD
HELICAL SPRINGS
CUTAWAY VIEW (ACTUAL SIZE)
Your Answer to VIBRATION DETECTION PROBLEMS

WHETHER your vibration problem involves a giant locomotive, small electric motor, or other type of reciprocating or rotating machinery, or even a structure, the Consolidated 4-102 Vibration Pickup will serve you well as the sensing device.

This compact and rugged pickup, though simple in design, is a precision instrument that converts the mechanical vibrations to which it is subjected into electrical energy of comparable magnitude and wave form.

When used with suitable associated instruments, such as the Consolidated 1-110B Vibration Meter described below, the electrical output of the 4-102 may be converted, electrically, into terms of velocity, displacement, or acceleration, and then either indicated directly or permanently recorded, as you may desire.

Consult us concerning your particular problems, and we shall be pleased to advise you concerning the application of the 4-102 in their solution.



The CONSOLIDATED 1-110B VIBRATION METER is a compact, portable, self-contained instrument requiring no external accessories for operation other than a suitable vibration pickup, such as the 4-102. The 1-110B is a visual-indicating instrument for the measurement of vibratory displacement and velocity. The simple operation and compactness of this instrument make it indispensable for rapid vibration measurement.

For further information send for: Vibration Meter Bulletin CEC 1505-X2; Velocity Pickup Bulletin CEC 1507-X2.

Analytical Instruments for Science and Industry

CONSOLIDATED ENGINEERING CORPORATION

620 NORTH LAKE AVENUE • PASADENA 4, CALIFORNIA

in auxiliaries. Wiring is made easy by a front mounted terminal board of moulded plastic.

Damage to the transformer even under sustained overload or accidental short circuit conditions is prevented by a built-in overload protector with time delay action.

New Sizes in Nugent Liquid Filters

Wm. W. Nugent & Co., 407 North Hermitage Ave., Chicago 22, Ill., announce a new size of their well-known, Fig. 1116 Bag Type Liquid Filters, also their Fig. 1280 Absorbent Type Liquid Filters, both operating under pressure.

For full flow filtering, which means that all the liquid piped to the filter is filtered and none by-passed therein. This new size filter is known as Fig. 1116PY size 1S. The operation is explained on page one and the top of page 2 of bulletin 7B. This filter, Fig. 1116PY size 1S, comes in sizes 1R to 4R. When filtering lubricating oil of 200 SSU viscosity oil, the capacity will be 2$^1/_2$ GPM at about 3 pounds pressure drop through the filter.

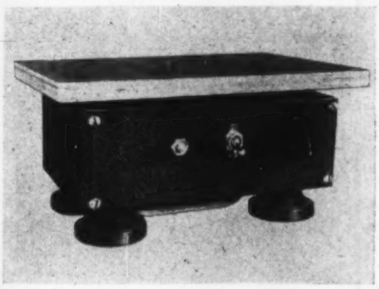
This 1S size filter is also made in an absorbent type using a cellulose material as a medium for filtering. The operation is illustrated and explained on pages 2, 3, and 4 of bulletin 7B.

When filtering lubricating oil of 200 SSU viscosity the capacity for a polishing job of filtering is 6.8 GPM at 35 pounds pressure drop through the filter. If this filter is connected to an internal combustion engine having a large oil circulating capacity the entire amount of the circulation from the pump may be piped to the filter and a 6.8 GPM mentioned above may be filtered while a larger capacity of 16 GPM may be by-passed through a relief valve within the filter, thus greatly simplifying the connecting piping to and from the filter.

Both the bag type and the absorbent type filters have had over a year's field tests on high speed, 200 HP Diesel engines and have shown excellent results.

The overall height of both types of filters is 24$^1/_4$", diameter 7", net weight 24 pounds, inlet and outlet $^1/_2$" ips. Send for Bulletin 7B.•

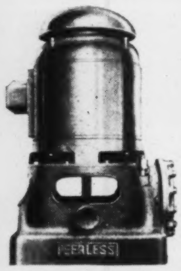
New, Small, Electro Magnetic, Vibratory Packer and Paper Jogger



Syntron Co., 855 Lexington Avenue, Homer City, Pa., announces the addition to their line of paper joggers and vibratory packers of a new small model with built-in variable control power, a 7" by 10" wooden

Peerless

Builds the Pump you require in Vertical and Horizontal Types



PEERLESS DEEP WELL VERTICAL TURBINE PUMPS

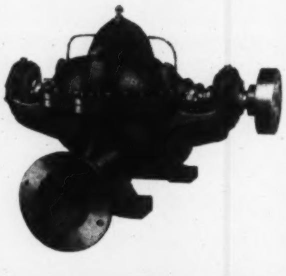
Oil or Water Lubricated Types

Peerless Moturbo Drive illustrated

Capacities: 15 to 30,000 g.p.m.; Lifts: to 1000 feet; Drives: electric, gear, belt or combinations. For wells 4" inside diameter and larger. Embodies patented Double-Bearing and Double-Seal Bowl construction.

PEERLESS TYPE A CENTRIFUGAL PUMP

General Specifications: Capacities: 50 to 70,000 g.p.m.; Heads: 15 to 300 feet; Sizes: 2" to 42" discharge; Drives: electric and other types from 1 to 1000 h.p.; Type: single stage, double suction, split-case, ball bearing. REQUEST DESCRIPTIVE BULLETIN.



PEERLESS PUMP

Peerless Vertical Turbine Pumps complement the extensive Peerless Centrifugal Pump line and are adaptable to the widest pumping conditions. Peerless' vertical type pump line includes turbine pumps, propeller and mixed flow pumps, Hi-Lift pumps and domestic water systems for deep or shallow wells. REQUEST BULLETIN.

PLAN WITH PEERLESS

For all your pumping requirements, plan with Peerless. Peerless' comprehensiv line of pumps includes Underwriters' approved vertical and horizontal Fire Pumps for plant fire protection, boiler feed and pipe line pumps and scores of vertical and horizontal types offering capacities from 10 to 220,000 g.p.m.

PEERLESS PUMP DIVISION

FOOD MACHINERY CORPORATION

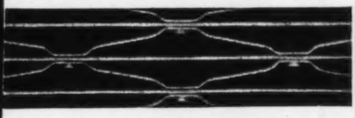
Factories: Los Angeles 31, Calif.; Quincy, Ill.; Indianapolis, Ind.

District Offices: Chicago 40, 4554 No. Broadway. Philadelphia Office: Suburban Square, Ardmore, Pa. Atlanta Office: Rutland Building, Decatur, Georgia; Dallas 1, Texas; Fresno, Calif.; Los Angeles 31, California.

IRVING GRATING

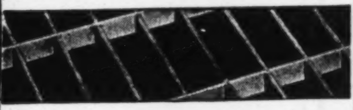
FLOORING AND STAIR TREADS

"A Fitting Grating for Every Purpose"



Riveted

Walkways — Stair Steps — Platforms
Trucking Aisles — Trench Covers



Press-Locked

Industrial Plants — Oil Refineries
Chemical Plants — Power Houses
Naval and Merchant Ships
Locomotive, Passenger and Freight Cars

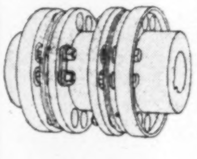
Welded

Catalog for the asking.

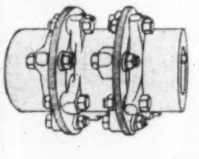
IRVING SUBWAY GRATING CO., INC.
ESTABLISHED 1902
HOME OFFICE and PLANT: 5010 27th STREET
LONG ISLAND CITY 1, NEW YORK
WESTERN DIVISION: FOOT OF PARK AVE.
EMERYVILLE 8, CALIFORNIA

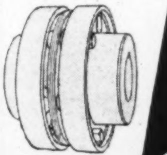
THOMAS
Flexible ALL METAL
COUPLINGS

Engineered to stand up on the toughest jobs, Thomas Flexible Couplings do not depend on springs, gears, rubber or grids to drive. All power is transmitted by direct pull.

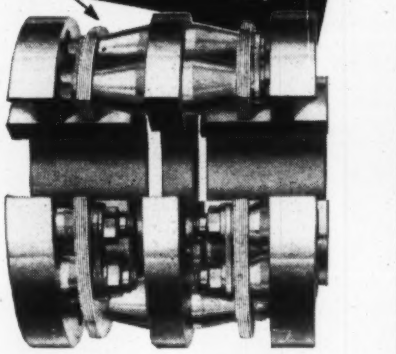


The standard line of Thomas Couplings meets practically all requirements. But if unusual conditions exist we are equipped to engineer and build special couplings.





BACKLASH FRICTION WEAR and CROSS-PULL are eliminated
NO LUBRICATION REQUIRED!



THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT

Write for New Engineering Catalog

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA

• Keep Informed

deck standing $4^1/_2''$ high and weighing but 13 pounds.

It is an extremely portable piece of equipment that can be used for a number of jobs—by the printer for jogging $8^1/_2''$ by $11''$ sheets prior to cutting, feeding or binding; in large offices aligning quantities of invoices for filing and gathering sales and service manuals; for completely filling small phials, jars cartons, or cans with bulk materials, or by dental laboratories for vibrating denture molds.

Literature and prices are available from the manufacturer.

SKF Speeds New Equipment Program

Driving to cut costs with more efficient machinery, SKF Industries, Inc., expects to complete its two-year $4,000,000 modernization program in 1948. Shown here is new super-precision machine installed in Philadelphia plant to grind bores of machine tool bearings to tolerances as fine as eighty-one-millionths of an inch.

Hannifin Develops New Fast-Cycling Electric Air Control Valve

A new electrically operated 4-way valve for directional control of the flow of compressed air is announced by Hannifin Corp., 1101 S. Kilbourn Avenue, Chicago 24, Ill. Designed primarily to provide a fast-acting push button control for small, air operated presses and similar units, the valve also has application as an automatic control for any air operated unit through the use of limit switches or mechanical stops.

The valve itself is a newly developed "packless" reciprocating disc type, pilot operated and solenoid controlled. The piston is aluminum and the disc is hardened stainless steel. It is built in two types: Type I is arranged for double solenoid operation using two push buttons or limit switches. Valve position is determined by energizing the proper solenoid. Type II is arranged for power offset operation using a single push button or limit switch. The valve returns to its initial position when the solenoid is de-

Continued on Page 46

A.W. FABER ... CASTELL
S.A. 9400 2H

LOOK-One Hand!

A. W. Faber's quick-action (black or colored)

LOCKTITE

refill works the thumb

drawing pencil with a flip of

1). Patented collet to hold lead in bull-dog grip.
2). One-hand clutch operation to avoid touching lead and smearing fingers.

These are but two exclusive features which make LOCKTITE the favorite of professional men. Collet prevents lead breaking or slipping. Try this clean, balanced, sturdy mechanical beauty and you will surely want to own it.

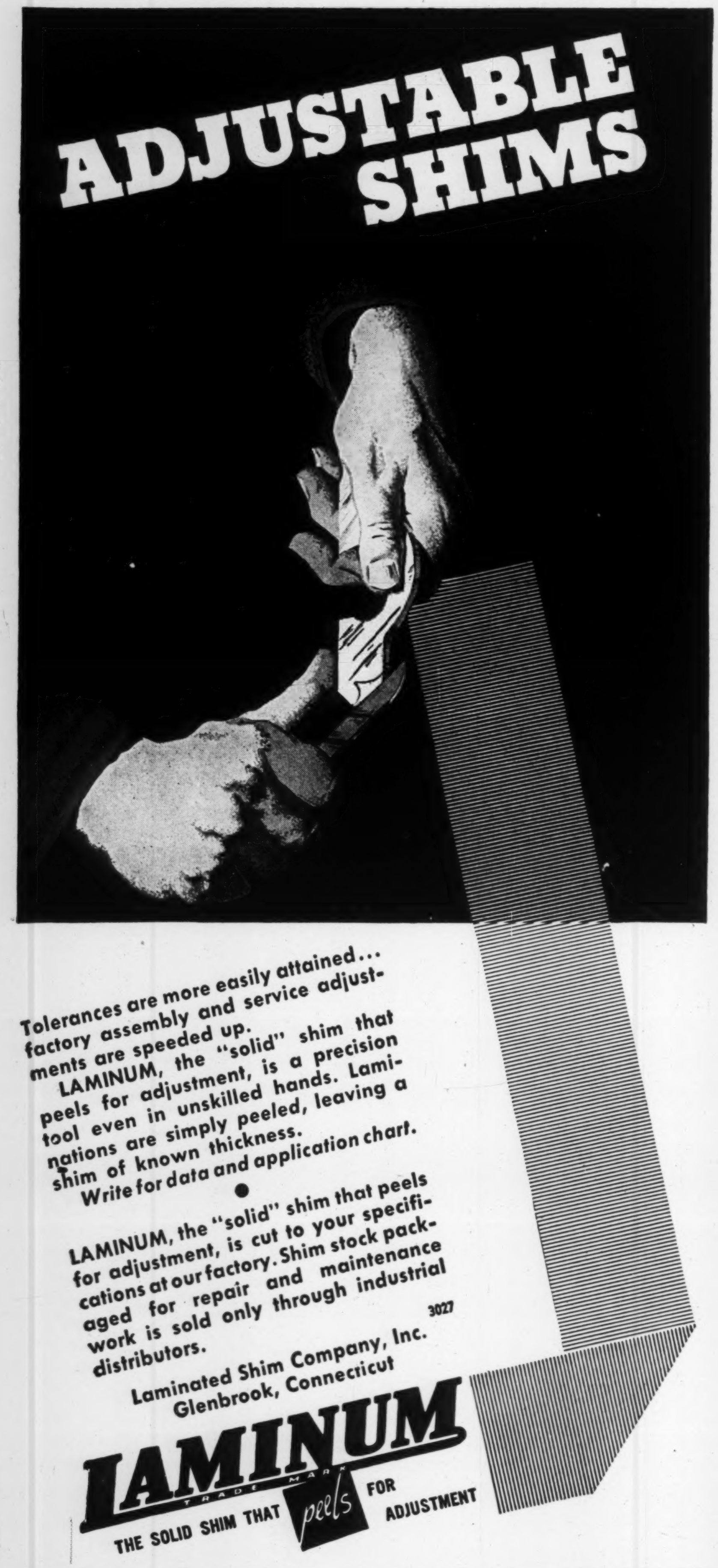
Holds all standard graded drawing or retouching leads. Winner Techno-TONE No. 1930 assures best results.

ALSO AVAILABLE IN RED, BLUE, GREEN, YELLOW, CARMINE, ORANGE and WHITE —holding hardy WINNER Techno-TONE crayon leads for coloring, sketching and checking.

BLACK in degrees 4B to 9H. Sold at Stationers', art and drawing supply stores, photo supply shops and Blueprinters.

GUARANTEED OF COURSE!

A.W. FABER-CASTELL
PENCIL COMPANY INC. NEWARK 4, N.J.



Tolerances are more easily attained... factory assembly and service adjustments are speeded up.

LAMINUM, the "solid" shim that peels for adjustment, is a precision tool even in unskilled hands. Laminations are simply peeled, leaving a shim of known thickness.

Write for data and application chart.

●

LAMINUM, the "solid" shim that peels for adjustment, is cut to your specifications at our factory. Shim stock packaged for repair and maintenance work is sold only through industrial distributors.

3027

Laminated Shim Company, Inc.
Glenbrook, Connecticut

LAMINUM
TRADE MARK
THE SOLID SHIM THAT *peels* FOR ADJUSTMENT

energized. Either type is capable of as many as 180, or more, operating cycles per minute in handling any air pressure from a minimum of 25 p.s.i. to a maximum of 150 p.s.i.

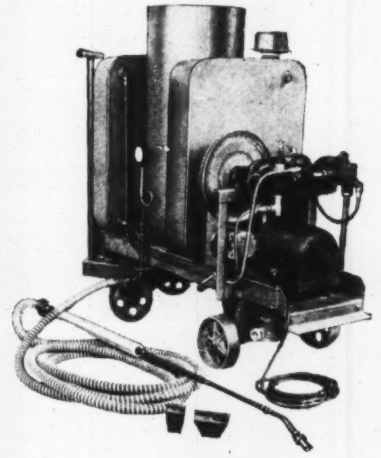
Electrical power consumption is small; Type I units are rated at 10 watts, Type II units at 20 watts. Standard models are built for 115 volt, 50–60 cycle circuits, but can also be supplied for 230 volt, 50–60 cycle power, or for D.C., low voltage A.C., and for other frequencies.

Compact and streamlined in appearance, the valve is offered in three models. Model NE-37 is tapped for $^3/_8''$ dia. inlet and cylinder and $^1/_2''$ exhaust pipe connections. Model NE-50 has $^1/_2''$ inlet and cylinder and $^3/_4''$ exhaust. Model NE-75 has $^3/_4''$ inlet and cylinder and 1" exhaust. Wiring diagrams and dimensions are contained in a new bulletin NP-1006.

Westinghouse Life-Line Capacitor Motors Coming Off the Production Line at Buffalo

Designed to drive air conditioning compressors, commercial refrigeration compressors, garage type air compressors, fans, blowers, small paint compressors, and water supply systems these motors operate on single phase, 110 or 220-volt electric service. There is a size for every need as they are available in 1, $1^1/_2$, 2, 3, 5 and $7^1/_2$ hp ratings.

New "Utility" Model "Hypressure Jenny" Steam Cleaner



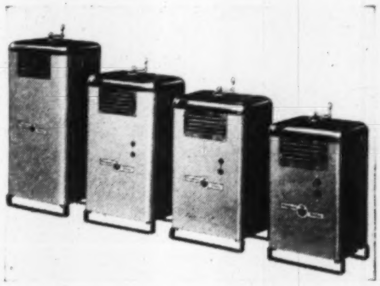
A new "Utility" Model "Hypressure Jenny" Steam Cleaner has just been announced by the "Hypressure Jenny" Division of Homestead Valve Manufacturing Co., Coraopolis, Pa. It is said to be a full-powered, extra heavy duty, all-purpose steam cleaner and is priced at three hundred and forty-eight dollars.

In addition to super cleaning capacity and low price, the new unit features instant starting (ready to clean in less than a minute); simplicity of design and operation; rugged welded unit construction; complete accessibility of all working parts; continuous electric spark ignition; non-clogging heating coil; and pressure atomizing oil burner.

A choice of either oil or natural gas burner, and electric motor driven or gasoline engine driven mechanism, make the new unit adaptable to most any operation requirements.

Westinghouse Low Voltage Industrial Welder

A new and smaller designed Flexarc industrial line of a-c welders is available from Westinghouse. A sturdy, compact, streamlined case and a well arranged interior with reactor and transformer built around high permeability Hipersil steel cores are features of the new line.



Called "The 65 Line" for the open circuit voltage, these new welders incorporate the latest engineering features assuring high arc stability in the lowest as well as the highest current ranges of the five output ratings—200, 300, 400, 500 and a duplex 300/600 amperes.

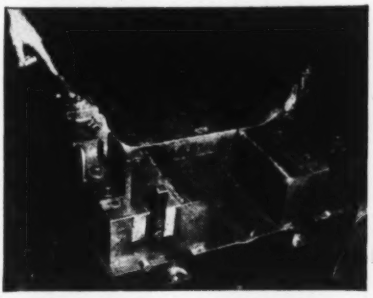
Built-in low voltage control assures high operating efficiency in the low current range; built-in capacitors assure a high power factor and economical full rated operation.

Natural ventilation, movable core reactor operated by single ball crank current adjusting mechanism—a Westinghouse pioneered development in a-c arc welder construction—guarantee minimum maintenance and attention. To reduce overall size and maintain uniformly high operating efficiency fan cooling is employed in the 500 ampere ratings.

Heavy duty castors for extreme portability and strap skid mounting on stationary units add to the welder serviceability.

Further information on these welders may be secured from the Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

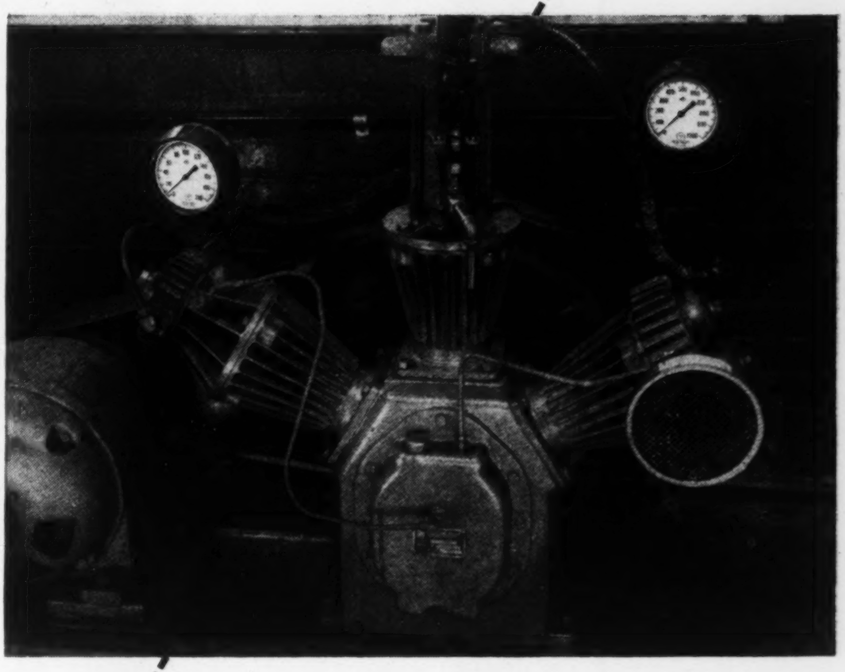
Lincoln Electric Announces New Electrode Toolweld A & O for Simplified Hard Surfacing of Tools and Dies



The Lincoln Electric Co., Cleveland, Ohio, announces a new electrode, Toolweld A & O, for hard surfacing tools and dies. The new electrode is designed to simplify procedures

Continued on Page 48

Here's how HELICOID GAGES

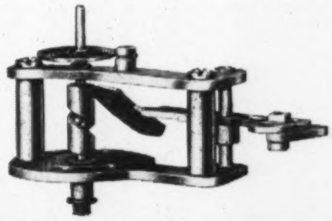


PAY OFF!

On a compressor like this, where you have vibration and rapid pressure pulsations, ordinary gages with clock gear movements last but a short time. Sometimes the gears are worn out in a few weeks.

By comparison, Helicoid gages wear for years. Actually, the gages shown here have been in service for 2½ years and are still going strong.

This is an example of the saving in maintenance which can be made by using Helicoid—the gage of enduring accuracy.

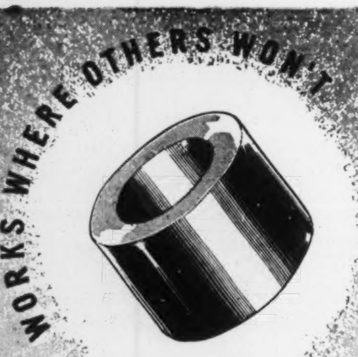


Only Helicoid Gages have the Helicoid Movement

ACCO

HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE
Bridgeport 2, Connecticut

TRADE MARK



WORKS WHERE OTHERS WON'T

accurately formed

GRAPHALLOY OILLESS BEARINGS

SPECIFY GRAPHALLOY TRADE MARK REG. U. S. PAT. OFF. WITH CONFIDENCE

SELF-LUBRICATING ○ EXTREMELY DURABLE ○ CONSTANT CO-EFFICIENT OF FRICTION ○ OPERATES DRY — OR SUBMERGED IN WATER, GASOLINE OR CORROSIVE LIQUIDS ○ APPLICABLE OVER A WIDE TEMPERATURE RANGE — *even where oil solidifies or carbonizes* ○ EXCELLENT AS A CURRENT-CARRYING BEARING.

GRAPHITE METALLIZING CORPORATION

1058 NEPPERHAN AVENUE, YONKERS 3, NEW YORK

• Keep Informed

and reduce the cost of depositing surfaces of weld metal of tool steel quality.

"Toolweld A & O," ("A" for air-quench; "O" for oil-quench) is for use in building up the working surfaces or edges of cold-working metal cutting and forming tools. It will produce surfaces of high strength for resisting wear and impact in all applications where high temperatures are not encountered. When deposited on either ordinary carbon steel or on any one of the hundreds of alloy steels, "Toolweld A & O" produces a surface whose properties will match those of the best tool and die steels.

The deposited weld metal is of the 5% chrome type and may either be used as welded or subjected to a wide range of heat treatments. When used on ordinary steel, the weldment may be heat treated to give the maximum hardness quality in the weld. When used on tool steel, the weldment may be heat treated as is demanded by the nature of the base material.

"Toolweld A & O" is a versatile, low-cost electrode recommended for the economical manufacture of composite metal working tools by using a carbon steel base and building up edges of tool steel quality, or for the alteration or repair of hardened dies and tools. Successful applications can be made on such tools as blanking dies, forming dies, die casting dies, upsetter dies and punches, forming rolls, burnishing tools, centerless grinder rests, planer ways, flash shearing dies and punches.

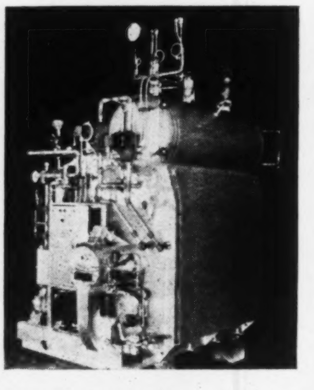
The electrode will operate on either AC or DC current, electrode negative with DC. It will deposit a thick bead in one pass in the low current portion of the operating range, and a thin bead in the high current portion of the range. Thin beads are smooth and flat requiring a minimum of grinding.

"Toolweld A & O" is packed in 10-pound containers. The following table gives sizes manufactured and their current ranges:

Electrode Size	Ampere Range
$^3/_{32}''$	40–85
$^1/_8''$	65–130
$^5/_{32}''$	95–180

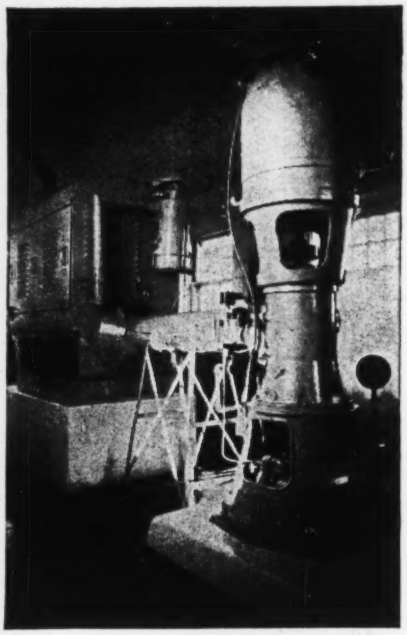
Package Steam Generators

Foster Wheeler Corp., 165 Broadway, New York, N. Y., announces its entry into the field of package steam generators up to and including 27,000 lb. per hour range. These Foster Wheeler units are assembled at the factory, including refractory and insulation, and are ready to generate steam when delivered and installed.



Designs immediately available provide for both oil and gas-firing, and a coal-fired unit will be ready shortly. Two series, low pressure (up to 250 lb.), and high pressure (up to 850 lb.), are being produced at present.

IN CASE OF *Power* FAILURE



The city of Margate, New Jersey no longer worries about an unforeseen powerline failure. Their newly installed million gallon per day Layne Well Water System is DUAL POWERED. Should the power fail and the electric motor "go dead" a big husky gasoline engine takes over to keep up water production.

Margate's new dual powered water system is a quality installation throughout with the very latest Layne developed control and engineering features. And like two other Layne installations for Margate—one of which is over 23 years old, this new unit will also give years and years of satisfactory operation.

Layne Well Water Systems whether installed for cities, factories, railroads, irrigation projects or other use, keep water production at the very lowest cost. Furthermore Layne associated companies constantly provide prompt repair and parts service for their Layne installation. For late catalogs, address Layne & Bowler, Inc., General Offices, Memphis 8, Tennessee.

LAYNE WELL WATER *Systems*

AFFILIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. ★ Layne-Atlantic Co., Norfolk, Va. ★ Layne-Central Co., Memphis, Tenn. ★ Layne-Northern Co., Mishawaka, Ind. ★ Layne-Louisiana Co., Lake Charles, La. ★ Louisiana Well Co., Monroe, La. ★ Layne-New York Co., New York City ★ Layne-Northwest Co., Milwaukee, Wis. ★ Layne-Ohio Co., Columbus, Ohio ★ Layne-Pacific, Inc., Seattle, Wash. ★ Layne-Texas Co., Houston, Texas ★ Layne-Western Co., Kansas City, Mo. ★ Layne-Minnesota Co., Minneapolis, Minn. ★ International Water Supply Ltd., London, Ont., Can. ★ Layne-Hispano Americana, S. A., Mexico, D. F.

BEE-LINE ENGINES

The New Model 75

DESIGNED for UNIVERSAL USE

The new Model "75," incorporating the latest developments in engine design, is now in service where wide horsepower range and dependability are required.

Meehanite cast iron cylinder block, insert connecting rod bearings, Timken main bearings, air maze oil bath and low weight per horsepower are just a few features of the new "75."

ORDER NOW FOR PROMPT DELIVERY

For further information write:

Gladden Products CORP.

"28 years of engine building"

635E West Colorado Blvd., Glendale 4, Calif.

IMO-

The PUMP for SMOOTH FLUID FLOW

The steady, uniform flow produced by the rotors in an IMO pump is ideal for oil burner supply, hydraulic service and other applications requiring an even, smooth flow of fluid.

For information send for catalog I-133A.

IMO PUMP DIVISION of the
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

• Keep Informed

Basic engineering design provides for installation of super-heaters either as original equipment or for later addition. This means that plant operators are being offered complete steam generators, factory-built, which embody the same features found in central station units.

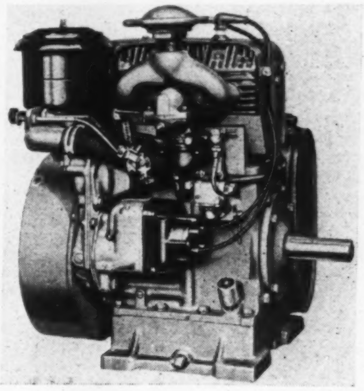
Combustion controls provide full or semi-automatic operation, as desired, and are an integral part of the "package." Operation of the units from a central control panel is simple—only a minimum of attention is necessary.

A bulletin containing full information is available on request.

Man Hunting a Noise

Armed with an audiometer (held in hands), a sound level meter (lower left), and a sound analyzer (lower right), this inspector performs one of the 34 quality control checks made on the Westinghouse Life-Line motor: hunting for unwanted noises. The audiometer is used to determine the wave length of the unwanted noise; the sound level meter to determine the decibel rating of the noise; and the sound analyzer to determine the relative amount of different frequencies resulting from the noise.

Wisconsin Motor Corp. Unveils Two-Cylinder Air-Cooled Engine



Kept closely "under cover" for the past three years, the latest addition to the famous line of Wisconsin Heavy-Duty Air-Cooled Engine now emerges and makes its official bow to the power-equipment trade. It's a two-cylinder job, supplied in two models, designated as "Models TE" and "TF."

Continued on Page 50

FREE!
MOLYBDENUM high speed steels

THIS LITTLE BOOK MAY SAVE YOU BIG PRODUCTION MONEY!

- Tells how you can save from 10¢ to 20¢ a pound on high speed steels and get better results!
- Gives actual shop tests and comparisons!
- Practical data on heat treatment!
- Tells you how manufacturers are cutting production costs!

MOLYBDIC OXIDE — BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE" • CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

MOLY
Climax Molybdenum Company
500 Fifth Avenue • New York City

MAIL COUPON TODAY!

CLIMAX MOLYBDENUM COMPANY ME-2
500 Fifth Avenue, New York 18, N. Y.

Please send me a copy of your free booklet

Name..............................

Company..............................

Address..............................

These engines round out a complete line of 4-cycle air-cooled engines, from 2 to 30 hp., now available in single cylinder, two-cylinder and V-type four-cylinder types.

The new engines embody the same basic heavy-duty design and construction features that are characteristic of all Wisconsin Air-Cooled Engines—such as Timken tapered roller bearings at both ends of the counter-balanced, drop-forged crankshaft; weather-sealed high-tension outside magneto equipped with impulse coupling for quick starts in any weather, at any season; honed cylinders; super-finished crankpins; extra-long connecting rods ($2\frac{1}{2}$ times the length of the crank throw); pump lubrication with individual oil stream to each rod; fuel pump as standard equipment; built-in flyball governor; oil bath air cleaner; $\frac{3}{4}''$ standard float feed carburetor.

The Model TE, operating at 1600 to 2600 rpm. carries ratings of from 8.3 hp. to 11.2 hp. The model TF, at the same speeds turns up from 9.9 to 13.3 hp. Standard engine weighs 220 lbs. Also available as housed power unit, weighing 255 lbs.

These engines can be supplied with electric starter and generator, clutch take-off assembly and clutch reduction assembly. They are regularly furnished to operate on gasoline but can also be furnished to burn other fuels.

The new two-cylinder engines fill the gap which has existed in the past between the single-cylinder line (2 to 9 hp.) and the V-type 4-cylinder line (up to 30 hp.). The manufacturer anticipates an active demand for the new engines for all types of power service within their hp. range.

Currently, Wisconsin Motor Corp., Milwaukee, Wis., is supplying engines to many of the country's leading manufacturers as standard power equipment for a great variety of machines in the farm field, construction service, oil field service, highway and railway maintenance and for many types of industrial applications.

Wisconsin Air-Cooled Engines are also extensively sold throughout the world by distributors and Authorized Sales and Service dealers.

High Milk, Yeast Drying Yield With High Temperature Condensate Return

Applications of high pressure condensate return systems produce impressive savings wherever high pressure steam is used for heating, drying, evaporating, or other process operations. The most tangible benefit from such systems is the increased production rates and improved quality of product resulting from the maintenance of uniformly high heat transfer efficiency.

In one plant processing spent grain from breweries and distilleries for stock feed, a double-drum dryer is used for reclaiming high-vitamin brewer's yeast. Steam is supplied the yeast dryer at 60 psi. The condensate return system evacuates the drums at 50 psi. Previously the returning

HAERING
ORGANIC
GLUCOSATES
control
SCALE
CORROSION
ALGAE
in
Industrial
Plants
WRITE ON YOUR LETTERHEAD
FOR SPECIAL LITERATURE

H·O·H
WE READ WATER

D. W. HAERING & CO., Inc.
GENERAL OFFICES:
205 West Wacker Drive, Chicago 6, Illinois

Polaroid*...
Photoelastic
Polariscope
for Stress Determination

For either qualitative or quantitative photo-elastic analysis, perfection in the projection lens system is of major importance.

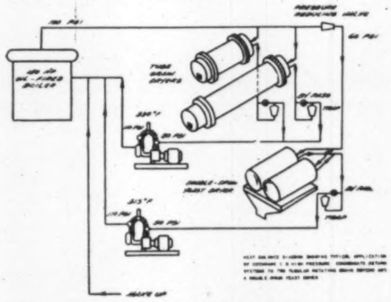
In our new model polariscope of $4\frac{1}{4}''$ clear aperture, the parallel beam is collected by a rear element and condensed through a three component lens of the Cooke system. In the new larger unit ($8\frac{3}{4}''$ aperture) a four component lens of the Omnar system is used. *The image is sharp throughout the field, free of aberration, astigmatism, and distortion.*

Literature of new model polariscope now available

POLARIZING INSTRUMENT CO., Inc.
Mount Kisco, N. Y.

**T.M. Reg. U. S. Pat. Off. Polaroid Corporation*

condensate was flashed in an open hot-well and was partially wasted.



The thin milky fluid containing the valuable brewer's yeast coats the drums at the center, flowing by gravity from an overhead storage tank. Long knives scrape the dried yeast from the outer surfaces of the drums and drops it into troughs where screw conveyors carry it to the front of the dryer. Here it is picked up by a pneumatic system and carried to an overhead hopper to await bagging in 100-lb bags.

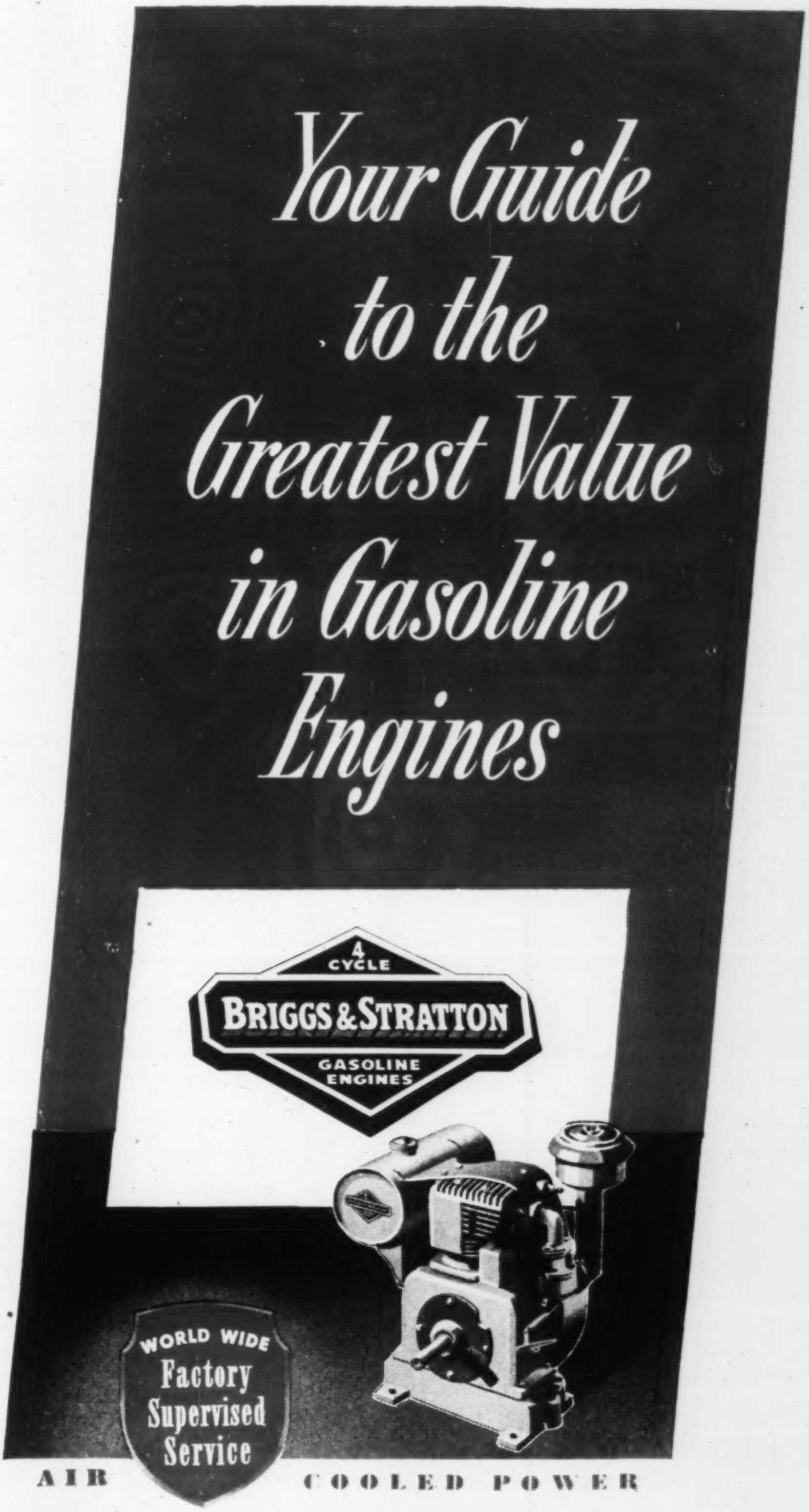
Principal advantage of the drainage system in this installation is that high drying temperature insures uniformity of dried grain and yeast and reduces to a minimum the possibility of spoilage from excess moisture after bagging. Since installation of the Cochrane C-B high pressure condensate return system only one of two 150-hp boilers has been required to carry the entire plant load. This has resulted in reduced maintenance and repair bills and considerably reduced repair costs.

New Metals Comparator Announced by G.E.

An electronic instrument called the metals comparator has been introduced by the Special Products Div. of the General Electric Co. for providing a quick, non-destructive comparison of either magnetic or nonmagnetic metal parts with a standard. Parts appearing alike but differing in composition can be separated quickly with the new instrument. It has been used to differentiate between annealed and unannealed steel bars, and also to sort finished metal parts with different compositions or heat treatments.

The metals comparator employs a balancing network and indicating instrument mounted in a steel cabinet to which is connected an external test coil. In operation, a reference specimen for the group of specimens

Continued on Page 52


Your Guide to the Greatest Value in Gasoline Engines
4 CYCLE
BRIGGS & STRATTON
GASOLINE ENGINES
WORLD WIDE
Factory Supervised Service
AIR COOLED POWER

The record for dependable performance... made by more than 3¼ million Briggs & Stratton engines built during 28 years of *continuous production*... stands unequalled. No other manufacturer has built so many 4-cycle air-cooled gasoline engines, or has had such long experience in building them. This experience, and the proven ability to deliver maximum performance year after year — maintain Briggs & Stratton engines *as the foremost power value* for industrial equipment, farm machinery and appliances.

BRIGGS & STRATTON CORPORATION, MILWAUKEE 1, WIS., U. S. A.

ANOTHER TIME-TESTED STUART PRODUCT
Stuart's
ThredKuT
HEAVY DUTY CUTTING OIL

MEET PRODUCTION SCHEDULES

...Use ThredKuT * on your Toughest Machining Jobs

*** THREDKUT, a versatile, heavy-duty cutting oil, is famous for its top performance on jobs found to be too tough for other oils. Due to the stabilized balance between its uniformly high anti-weld value and its other desirable cutting characteristics, it is especially efficient in the machining of tough, stringy metals and for the more difficult operations, such as thread cutting, tapping, broaching and gear shaping.**

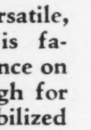
As supplied, THREDKUT is scientifically correct for the severest metal-working conditions. For less severe conditions, it can be diluted with from 4 to 20 parts of low-cost blending oil. Properly applied, it will out-perform competitive cutting fluids on 3 out of 4 machine operations.

For details and literature on THREDKUT and other Stuart cutting fluids, write today.

STUART *oil engineering goes with every barrel*

D.A. Stuart Oil CO.
EST. 1865 LIMITED

2741 S. TROY STREET, CHICAGO 23, ILL.



• Keep Informed

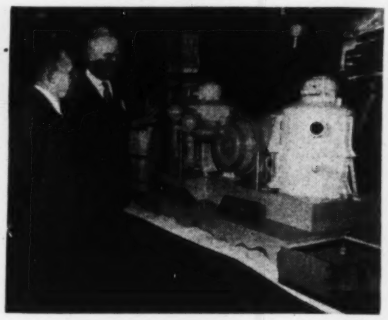
being compared is first placed in the test coil and adjustment made to secure the initial balance. This is indicated by a zero reading on the indicating instrument. After the reference specimen has been removed, the parts to be tested are inserted briefly in the coil one by one. When tolerances have been established, specimens can be accepted or rejected on the basis of the dial reading. As many as 1500 small parts can be tested in an hour.

The metals comparator is mounted in a steel cabinet about 11 × 17 × 22 in. and weighs a little less than 60 lb. Test coils of different sizes are available, ranging from $^1/_2$ in. to 3 inches inside diameter. Leads are of convenient length so specimens can be tested in any position adjacent to the instrument.

The equipment is designed for operation from 60-cycle commercial power supply at 115 volts. Because of the small size of the apparatus and the low power requirements, the instrument can be used in almost any location.

Additional information is given in GEA-4894.

New Type G-E Mercury Turbine



A. R. Schiller, president, Public Service Co., of New Hampshire (left), and T. S. Knight, General Electric commercial vice-president, view scale model of new type G-E 7500-kw mercury turbine to be installed by the Public Service Company of New Hampshire at Portsmouth, N.H. Two of these mercury units are being furnished for the 40,000-kw Portsmouth station, expected to be one of the most efficient in the world. The two complete mercury elements each consist of a mercury boiler, a 7500-kw, 1200-rpm turbine generator and condenser boiler. The steam output of each condenser boiler is passed through a superheater element in the combustion space of the mercury boiler. The steam flows are then combined at 600 lb., 825 F to feed a 25,000-kw, 3600-rpm steam turbine direct-connected to a hydrogen-cooled generator. Model was exhibited recently at the 23rd Annual New England Conference at Boston.

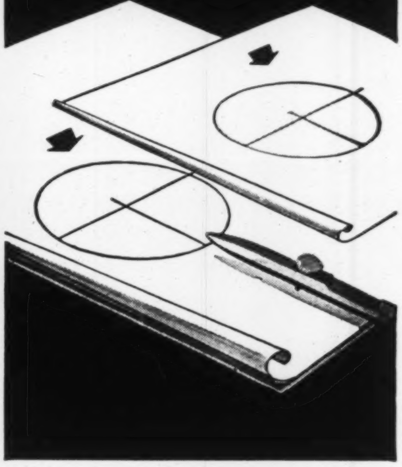
Improved Totally-Enclosed, Fan-Cooled, Wound-Rotor Motors

A line of improved totally-enclosed, fan-cooled, wound-rotor motors has been announced by the Allis-Chalmers Mfg. Co., Milwaukee, Wis. The motors are built with an improved tube-type air-to-air heat exchanger, first used for squirrel cage motors. The greater efficiency of this exchanger permits a reduction in size compared to older, totally-enclosed, fan-cooled designs. Because of its simple design, cleaning is seldom.

The improved motors are suitable for all fields of industry, since they can be readily adapted to suit the requirements of any special industry.

To assure trouble-free operation under extremely unfavorable atmospheric con-

Tracing cloth that defies time



• The renown of Imperial as the finest in Tracing Cloth goes back well over half a century. Draftsmen all over the world prefer it for the uniformity of its high transparency and ink-taking surface and the superb quality of its cloth foundation.

Imperial takes erasures readily, without damage. It gives sharp contrasting prints of even the finest lines. Drawings made on Imperial over fifty years ago are still as good as ever, neither brittle nor opaque.

If you like a duller surface, for clear, hard pencil lines, try Imperial Pencil Tracing Cloth. It is good for ink as well.

IMPERIAL TRACING CLOTH

SOLD BY LEADING STATIONERY AND DRAWING MATERIAL DEALERS EVERYWHERE

• Keep Informed

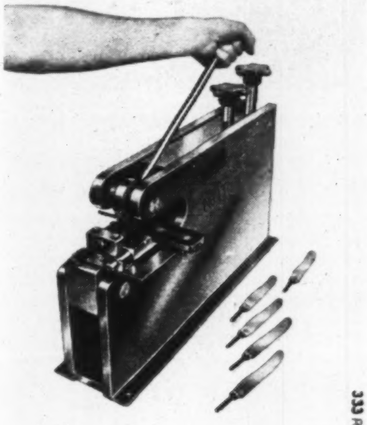
ditions, the motors can be built with stainless steel ventilating tubes, fans, and end plates and cast iron terminal boxes and collector ring enclosures.

Built with these special features, the 500-hp, 705-rpm, 2300-volt motor is to be used for driving a centrifugal pump in a midwestern chemical plant. Its collector assembly is cooled by radiation, with internal air circulation provided by fan blades mounted on the collector assembly.

Acromark Offers New Machine for Cutlery Marking

A new multi-lever spring tension pressure marking machine for marking cutlery blades and other tapered or beveled parts is offered by The Acromark Co., Elizabeth, N.J.

This machine is constructed for mounting on a work bench and easily marks the word "Stainless" in $^3/_{64}$" size lettering or names in one or more lines of larger or smaller size letters or design into finished blades by means of a roller die.



The machine itself is 14" high x 6" wide including the blade holder x 20" deep. The body of the machine is of welded construction provided with a flange at each side of the bottom for bolting to the work bench.

The roller die which is engraved with the letter or trademark design is precision engraved to proper marking depth and the background of the lettering is finished so that in full depth marking the background acts as a flattening agent, thereby preventing a throw-up of metal that would necessitate grinding and finishing of the blade after marking.

This roll die is mounted on an eccentric shaft that is in turn a part of a multiple lever arrangement that is controlled by hand screws applying spring pressure against the lever arrangement.

In actual operation, when the mark is sunk to predetermined depth the eccentric lever is lifted against the pressure spring which thereby provides for the variations in thickness of the blade or other part being marked insuring a uniform depth marking. Heretofore such control was only accomplished by hydraulic or air pressure, but this new development eliminates the necessity of such elaborate equipment.

The blade or work holder is mounted on an adjustable slide so that a simple adjustment assures the mark being placed in the same place on each piece and the open construction of the machine is such that the part to be marked may be easily fed from the front or the side. An easy pull of the lever rolls the mark into the blade and the slide holder

Continued on Page 54

ASSEMBLING REQUIRES NO SPECIAL FITTING

• Assembling is greatly simplified by Lunkenheimer precision production . . . parts are so accurately made that special fitting isn't necessary.

LUNKENHEIMER

Precision Workmanship

■ ■ ■

SUPER ACCURACY IN EVERY PART

...LONGER SERVICE LIFE

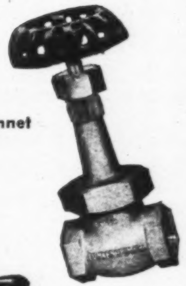


Fig. 2228
Bronze Union Bonnet Gate Valve

LUNKENHEIMER

Fig. 1430
Iron Body Gate

• You can't fool the maintenance men on valve quality. They know that when a valve has a much longer than average service life, that valve has superior accuracy and precision built into it from handwheel to pipe threads.

Such valves are the only kind that Lunkenheimer has ever produced. For over three quarters of a century, the Lunkenheimer quality ideal has won ever widening acceptance until today it is a recognized tradition in American industry.

Lunkenheimer quality is the balanced combination of many factors. Among them are finest raw materials approved by constant testing and research ... sound, advanced design ... highly skilled workmanship ... absolute accuracy ... perfect alignment of all parts.

As an inevitable result — wherever you find Lunkenheimer Valves you find maintenance cost records consistently lower.

Your LUNKENHEIMER Distributor

— is an important link in the nationwide Lunkenheimer chain of better, more efficient, more reliable valve service. He is fully equipped to assist in the solution of valve maintenance and operating problems. In addition, he can make prompt arrangements to have a Lunkenheimer Engineer call at the plant whenever technical valve engineering knowledge is required.

ESTABLISHED 1862
THE LUNKENHEIMER CO.
—"QUALITY"—
CINCINNATI 14, OHIO. U. S. A.

NEW YORK 13, CHICAGO 6, BOSTON 10, PHILADELPHIA 34. EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N.Y.

FOR BETTER LUBRICATION

PHONE YOUR

LUBRIPLATE DEALER

LUBRIPLATE Lubricants are sold by authorized dealers. This is a protection to LUBRIPLATE users for it is the responsibility of the dealer to see that only the proper LUBRIPLATE Product is used for the specific job. There is a LUBRIPLATE Lubricant for practically every application. Ask the LUBRIPLATE Dealer. It is his job to reduce your operating costs through better lubrication. For his name consult your classified phone book.

Rx FOR YOUR MACHINERY

No. 2 — Ideal for general oil type lubrication, ring oiled bearings, wick feeds, sight feeds and bottle oilers.

No. 8 — Because of high film strength and long life it reflects outstanding performance in most types of enclosed gears (speed reducers).

No. 107 — One of the most popular grease type products for general application by pressure gun or cups.

No. 70 — For a wide range of grease applications, especially at temperatures above 200 degrees F.

No. 130-AA — Known nationwide as the superior lubricant for open gears, heavy duty bearings, wire rope, etc.

BALL BEARING — This is the LUBRIPLATE Lubricant that has achieved wide acclaim for use in the general run of ball and roller bearings operating at speeds to 5000 RPM and temperatures up to 300 degrees F.

DEALERS FROM COAST TO COAST
CONSULT YOUR CLASSIFIED TELEPHONE BOOK

LUBRIPLATE
FISKE BROTHERS REFINING CO.
NEWARK 5, N. J. TOLEDO OHIO

• Keep Informed . . .

carries the blade along with the marking, returning as the lever is returned.

Constructed for years of service this new machine represents a substantial advance in the marking machine field. It is designated as Model No. 13 and further details will be promptly submitted by the manufacturer upon application to The Acromark Co., 345 Morrell St., Elizabeth, N. J.

New Line of Refrigeration Instruments Announced by United States Gauge

The release of the first instruments in a new group of refrigeration gauges to be sold under the trade name "Frostline", has been announced by United States Gauge, Division of American Machine and Metals Incorporated.

The first of the new gauges, specifically designed for the refrigeration industry, are of the portable type and include both a high and low side instrument either of which is available with or without a temperature equivalent dial scale.

Design features of these new instruments include an adjustable pointer for easy recalibration; a removable screw check to prevent damage to the Bourdon Spring from surges in pressure; large easy-to-read dials with 1" graduations on the low side (vacuum) gauge; luminous treatment of dials and pointers for greater legibility in semi-darkness; and finally, the low side (vacuum) gauge is actually a compound-retard gauge since it is protected to 200lb overpressure. This last feature is to protect against spring damage and necessary recalibration should a defective compressor over-shoot the 60lb upper working unit.

These units, available in sizes standard to the industry, are made to meet the specific requirements of refrigeration engineers.

New Photoelastic Resin to Aid Stress Study

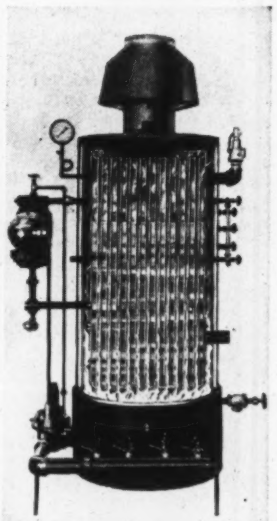
A special process developed by H. F. Minter and M. M. Leven of the Westinghouse Research laboratories now permits large sections of a photoelastic resin of the Fosterite family to be cast for three-dimensional studies of "frozen stresses." One piece measures six inches in diameter and 3 feet long and it is believed that sizes and shapes suitable for any kind of three-dimensional study can be produced. In the past

THE ANSWER TO YOUR STEAM PROBLEM

A KANE BOILER PACKAGE

Yes, it's a compact, self-contained steam source that includes: the correctly sized KANE Automatic Gas-Fired Boiler complete with burner and controls to maintain required steam pressure; and an M-K-O Automatic Boiler Feed system designed to return condensate and supply make-up water as required for highest operating efficiency.

Engineered Steam at its best with four decades of experience at your disposal—so, send your steam problem to us for study and recommendation.



The KANE Boiler is built to A.S.M.E. specifications, in sizes 1 to 30 H. P.

MEARS-KANE-OFELDT INC.
1903-1915 EAST HAGERT STREET, PHILADELPHIA 25, PA.
FOUR DECADES OF AUTOMATIC GAS-FIRED BOILER MANUFACTURING EXPERIENCE

Keep Informed

plastic models made of ordinary photoelastic resins have been limited to pieces 1/4 inches thick.

The new resin is 35% more optically sensitive for "frozen stress" measurements than the standard material, and does not fade in usefulness with time. It can be used for precision studies a month after machining.

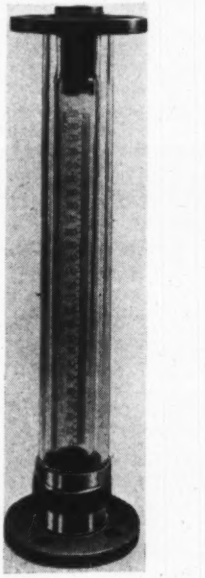
Photoelastic resins in actual use are made up into models, as for example a crane hook. After being heated, the model is loaded, and then cooled gradually to room temperature. When viewed through polarized light the plastic replica shows vividly the location, direction and magnitude of stresses.

Production of a model now takes about one month. Resin is poured into an evacuated glass mold which is then sealed and placed in a water bath. The temperature is then raised to 100°F. Subsequently the Fosterite is baked in an oven. Slow curing makes the resin essentially free of stresses.

The new resin is still in the experimental stage and is not yet available commercially.

Improved Rotameter

A new inexpensive Chemical Service Rotameter has been announced by Schutte and Koerting Co., Philadelphia. The improved Rotameter is rigid, self-supporting in a pipeline and the construction avoids expensive end fittings. Also, the need for stuffing boxes, which are expensive to build and maintain, has been eliminated. There is then no chance of product contamination by stuffing box packing materials.



The new design is made possible through the use of a recently developed Corning glass flange on the Rotameter tube. It may be connected directly to a standard four-hole flange—or with a companion flange it may be connected to a threaded pipe. Where required, a very thin neoprene gasket—which resists heat and many solvents—is provided. For special applications, this gasket may be supplied in Teflon, which is practically unaffected by heat and all chemicals.

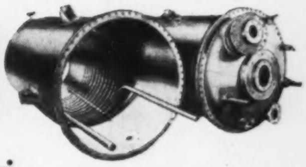
In standard models the rotor stop is hard rubber and the rotor is stainless steel. On special order, the rotor stop may be made of Pyrex glass or Teflon.

An integrally built Lucite tube covers and protects the measuring tube. The Lucite tube is fitted with a metal adjusting ring which permits the tube to be held rigidly in position by forcing it against cast iron flanges

Continued on Page 56

FAR BEYOND FIDELITY TO
BLUE PRINTS AND SPECIFICATIONS

NOOTER

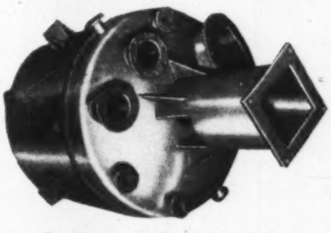


Interior and exterior of twin processing tanks of solid Monel. 5' diameter by 10' high.

Offers advanced fabrication techniques resulting from over half a century of progressive experience. Qualified as Specialists in metallurgical fabrication NOOTER makes available a background of technical knowledge of the properties and behavior of metals and alloys.

10" diameter x 26' long chemical tower made in five sections of pure copper. All welding was performed by the carbon arc method.

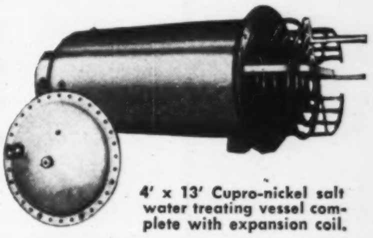
STEELS • • ALLOYS • • PURE METALS
LINED • • CLAD • • or SOLID PLATE



One of a battery of solid nickel processing tanks, 5' x 5', with steel agitator support on dished head.

Rigid adherence to your detailed specifications will determine structural exactness and efficient performance, but—

Include also an evaluation of NOOTER specialized services covering the many vital factors in plate work for strength and safety combined with resistance to corrosion and high temperatures.



4' x 13' Cupro-nickel salt water treating vessel complete with expansion coil.

Send for your copy of the new corrosion-resistant metal tables — just off the press.

NOOTER
ST. LOUIS

JOHN NOOTER Boiler Works Co. • 1432 S. Second St., St. Louis 4, Mo.

ANOTHER BIG JOB

fabricated by **DOWNINGTOWN**
IRON WORKS, INC.

This Creosoting Cylinder—weighing approximately 137,000 lbs.—is another example of Downingtown's design and fabrication experience. The Cylinder is 72" I.D. x 150' 0" long face to face of the door flanges . . . has a door at each end . . . is fabricated of A 70 Flange Grade Steel . . . and is designed for working pressures of 200 lbs. in accordance with Par. U 69 of the A.S.M.E. Code.

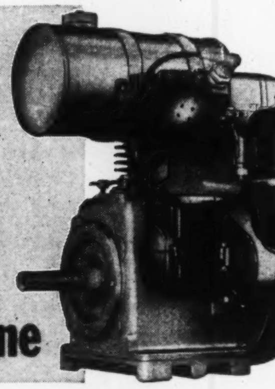
Our more than 30 years' specialized experience in the fabrication of metals has given us the ability and knowledge to handle practically all types of Plate Fabrication. We are equipped to handle, within our limitations, complete jobs in various metals and methods of construction to assure satisfaction in operation. Engineering consultation is available to aid you in the design and specifications for your specific application.

We also maintain a Heat Transfer Division under the direction and supervision of men thoroughly trained and experienced in this field. Consult us, also, about your Heat Transfer problems.

DOWNINGTOWN IRON WORKS
DOWNINGTOWN, PA.
WELDED and RIVETED PRODUCTS

NEW YORK OFFICE: 30 CHURCH STREET

You Get
HEAVY-DUTY SERVICEABILITY
in a Small Engine
WHEN YOU SPECIFY
WISCONSIN *Air-Cooled* Engine



In designing power-operated equipment within a 2 to 4 hp. range . . . one of the vitally important considerations is to secure a power unit that can be depended upon for *heavy-duty serviceability.*

This is one of the predominant characteristics of the little Models AB and AK Wisconsin Air-Cooled Engines. Every detail of design and construction . . . from the Timken tapered roller bearing mounting of the crankshaft front and rear, to the mirror-honed cylinder . . . has been engineered for heavy-duty operation under rugged conditions. These engines are equipped with rotary type outside magneto impulse coupling, assuring quick, easy starting in any weather, at any season.

Write for detailed specifications and other pertinent data. Wisconsin Air-Cooled Engines are available in 4-cycle single cylinder and V-type 4-cylinder models in a complete power range.

WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy Duty Air-Cooled Engines

at each end of the Rotameter. At the same time it holds the flanges in position for tightening against companion flanges in the pipeline where it is to be installed.

This Rotameter is available in sizes from $1/4$" to 4". Its low cost, simplicity and ease of installation should broaden the application of Rotameters in many chemical processes.

For further information, write to: Schutte & Koerting Co., 1166 Thompson Street, Philadelphia 22, Pa.

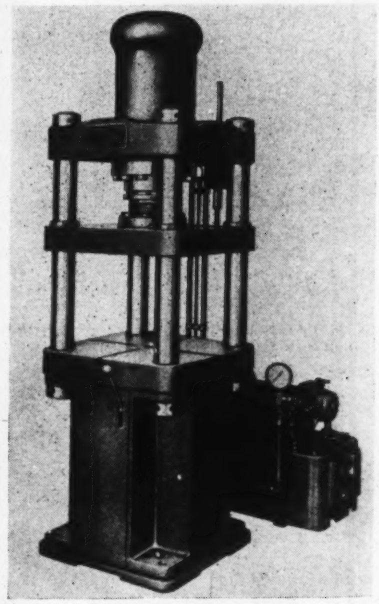
New Hycar American Rubbers

Two new Hycar oil resistant American rubbers have been introduced by B. F. Goodrich Chemical Co. and are in commercial quantity production. Designated as Hycar OR-25 EP (Easy Processing) and Hycar OR-25 NS (Non-staining), these new rubbers have superior processing characteristics over the regular Hycar OR-25. Hycar NS differs from Hycar EP only in that a different antioxidant has been added to the former, making it non-staining and non-discoloring. This is an outstanding advantage in the fabrication of light colored products where freedom from staining and discoloration are primary factors.

The principal advantages of these new Hycar rubbers over the regular process Hycar OR-25 are as follows: 1. Both Hycars band on the processing mill rolls very quickly, thereby decreasing mill mixing time. 2. Better extrusion characteristics due to less nerve and heat build-up. 3. Excellent high temperature mixing, such as Banbury operations. 4. Better fusion and mold flow characteristics. 5. Increased building tack for laminated products, such as frictioned stocks and calendered sheeting.

Preliminary investigation with these new Hycar rubbers indicate that to obtain an equivalent state of cure to the regular OR-25, the quantity of sulfur should be increased by .25 parts of sulfur to 100 parts of rubber polymer.

Hannifin Announces Standardized Line of Hydraulic Presses



Long a leader in standardization of pneumatic and hydraulic cylinders, Hannifin Corporation of Chicago has announced an important step forward in the standardization of hydraulic presses such as are used in a

• Keep Informed

wide variety of straightening, forcing, forming, assembling, broaching, and similar operations. In a special 20-page illustrated bulletin, just released to its representatives, Hannifin lists a total of seventy-five standard presses in capacities ranging from 6 to 150 tons which are available for prompt delivery with a wide choice of control equipment, accessories, and fixtures. In the past, such presses have usually required special engineering and design such as necessitated an extended delivery date. It is believed that the advantages of standardization will be attractive to many manufacturers who are now trying to plan for increased production and want equipment installed as quickly as possible.

The Hannifin standardized presses are designated as Series S straightening presses, Series F forcing presses and Series C column type presses. Series S presses are produced in seventeen different models which are intended to meet virtually any straightening press need. Series F open gap forcing presses are offered in ten different models. Both Series S and Series F feature Hannifin's "Sensitive Pressure Control" as standard equipment. This control permits varying the ram pressure in proportion to the pressure on the control lever. The control can also be set to apply a uniform repetitive pressure on production work.

Series C four column presses are built in forty-eight different models that provide a choice of 18", 36" and 60" space between columns, left to right, and in capacities ranging from 6 to 150 tons. Controls offered include manual, electric push button, and "sensitive pressure" types.

Detailed specifications and dimensions together with information and recommendations on the selection of presses are contained in the special bulletin. Readers can obtain copies of the bulletin by addressing Hannifin Corp., 1101 S. Kilbourn Ave., Chicago 24, Ill., and asking for Bulletin No. 130L.

Babcock & Wilcox to Build High Pressure Test Vessel for Navy's Underwater Sound Reference Laboratory

Barberton, O.—A high pressure test vessel will be built by The Babcock & Wilcox Co. for the U.S. Navy's Underwater Sound Reference Laboratory, Orlando, Fla., officials of the company announced here recently. This unit is similar to the one now being completed by the company for the Naval Ordnance Laboratory at White Oak, Md., but is designed specifically for Sonar measurements.

The vessel, which has an inside diameter of 100 inches and an overall straight length of 25 feet 8 inches, will have a 1,000 pound working pressure. It will be fabricated of 4-inch steel having an ultimate tensile strength of 70,000 pounds per square inch. The vessel will weigh approximately 77 tons.

Designed with two quick-opening nozzles for the introduction of test equipment, the unit will be used to test operation of instruments and fittings under actual conditions of pressure and temperature.

• *LATEST CATALOGS*

New Aldrich Triplex Pump Catalog

New Data Sheet No. 66 completely pictures and describes the Aldrich Inverted Vertical Triplex Pump for petroleum, central hydraulic and high pressure applications. It contains standard ratings, approximate

Continued on Page 58

DESIGN YOUR
PORTABLE TOOLS
FOR FREE AND
EASY OPERATION
WITH

S.S.WHITE FLEXIBLE SHAFTS

Photo courtesy of the Concrete Surfacing Machinery Co. Cincinnati, Ohio.

The concrete surfacer shown above makes clear the advantages of flexible shaft driven portable tools.

With the motor suspended from the operator's shoulder, or mounted on a movable stand, tool holders can be made smaller and lighter. This means easier manipulation over a wider range and with less fatigue.

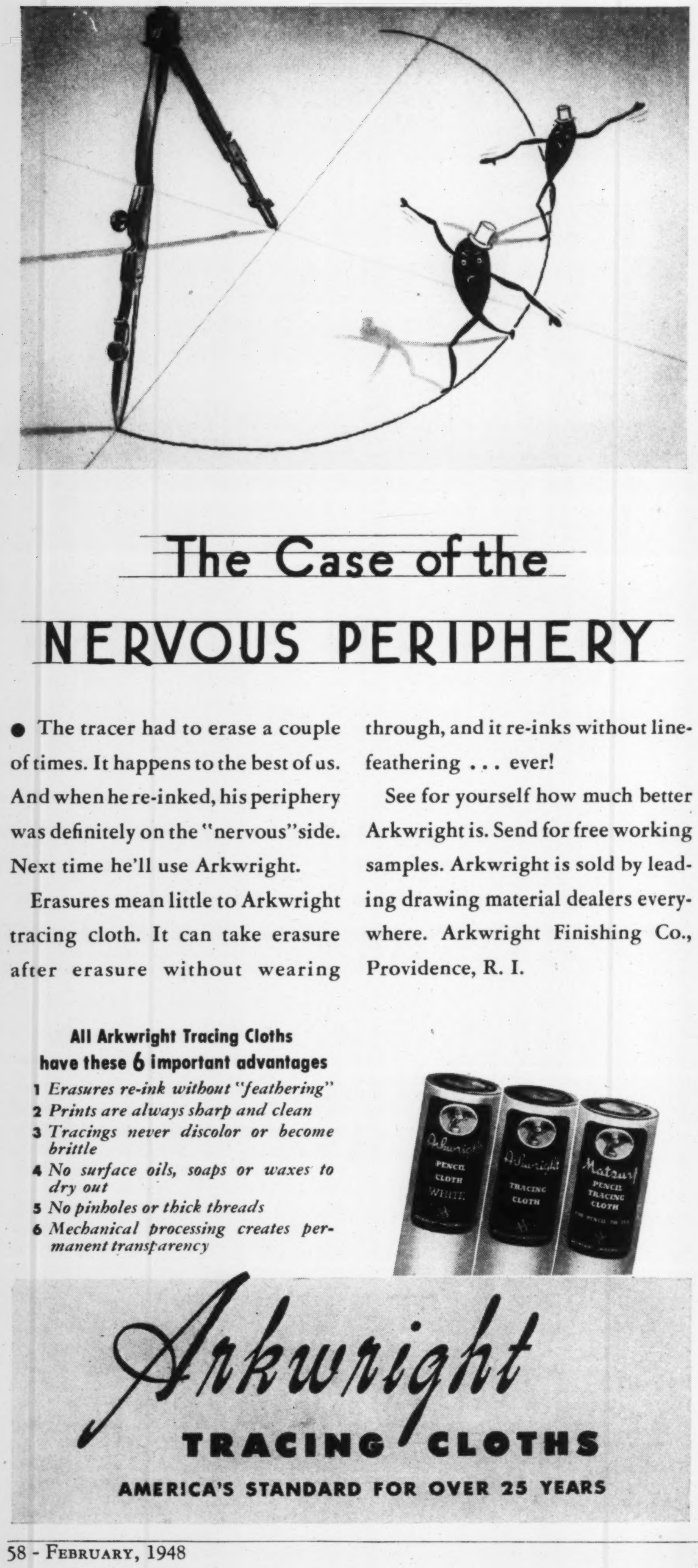
There are still many industrial operations being performed by hand which could be done faster, better, and more economically with a flexible shaft machine designed for the purpose. S.S.White offers its cooperation in applying flexible shafts for these developments.

WRITE FOR FLEXIBLE SHAFT HANDBOOK

It gives facts and technical data about flexible shafts and their operation. A copy sent free if you write for it on your business letterhead and mention your position.

S.S.WHITE INDUSTRIAL DIVISION
THE S. S. WHITE DENTAL MFG. CO.
DEPT. L, 10 EAST 40th ST., NEW YORK 16, N. Y.
FLEXIBLE SHAFTS • FLEXIBLE SHAFT TOOLS • AIRCRAFT ACCESSORIES
SMALL CUTTING AND GRINDING TOOLS • SPECIAL FORMULA RUBBERS
MOLDED RESISTORS • PLASTIC SPECIALTIES • CONTRACT PLASTICS MOLDING

One of America's AAAA Industrial Enterprises



The Case of the NERVOUS PERIPHERY

● The tracer had to erase a couple of times. It happens to the best of us. And when he re-inked, his periphery was definitely on the "nervous" side. Next time he'll use Arkwright.

Erasures mean little to Arkwright tracing cloth. It can take erasure after erasure without wearing through, and it re-inks without line-feathering . . . ever!

See for yourself how much better Arkwright is. Send for free working samples. Arkwright is sold by leading drawing material dealers everywhere. Arkwright Finishing Co., Providence, R. I.

All Arkwright Tracing Cloths have these 6 important advantages

1 *Erasures re-ink without "feathering"*
2 *Prints are always sharp and clean*
3 *Tracings never discolor or become brittle*
4 *No surface oils, soaps or waxes to dry out*
5 *No pinholes or thick threads*
6 *Mechanical processing creates permanent transparency*

Arkwright
TRACING CLOTHS
AMERICA'S STANDARD FOR OVER 25 YEARS

• Keep Informed

dimensions and diagrams of comparative discharge flows—describes the construction and operation of the pump—points out its low maintenance features. An isometric drawing and various charts are used to illustrate outstanding design features.

Copies of Data Sheet No. 66 can be obtained, free of charge, by writing to The Aldrich Pump Co., Allentown, Pa.

Steam Trap Selection Guide

"Selecting the Right Type of Steam Trap" is the title of a four-page, two-color bulletin issued by Sarco Co., Inc., of Empire State Building, New York 1, N. Y. This bulletin is copyrighted. An illustrated chart permits the reader, at a glance, to select the right type of steam trap for his particular application. The special features, advantages, and recommendations are listed for each type of trap. Large, cross-sectional illustrations make it simple to follow the text.

The company offers to send a free copy to any engineer or production man who actually buys, specifies, or recommends steam traps.

New Book Issued on Link-Belt Bulk-Flo Conveyor Units

A new, 48-page, copiously illustrated Book No. 2175, has been published by Link-Belt Co. on Bulk-Flo conveyors, and is now available for distribution.

The book is replete with engineering data, and valuable charts, tables and formulas to determine the Bulk-Flo size and proper operating speed for a given handling capacity and weight of material to be handled.

Bulk-Flo conveyors handling coal, soybean flakes, soybean meal, soda ash, flour, lime, sugar, soap chips, wood chips, peanuts, almonds, sawdust, chemicals, are illustrated.

The Link-Belt Bulk-Flo conveyor was developed for the mechanical handling of a great variety of bulk flowable granular, crushed, ground or pulverized materials of a non-abrasive, non-corrosive nature.

It is a feeder, conveyor and elevator all combined into one compact, adaptable unit, when so desired. It is self-feeding, self-discharging and largely self-clearing. It may also be used individually as a feeder, conveyor or elevator.

The Bulk-Flo conveying medium operates slowly within a dust-tight casing. It handles material gently with a minimum of breakage, degradation, dusting or contamination and is relatively low in first cost.

Link-Belt Bulk-Flo is one of the simplest and most versatile enclosed elevating, conveying units for handling flowable material in a continuous mass.

Travel may be horizontal, vertical or inclined, and a single self-contained unit may carry in these directions.

The conveying medium consists of an endless chain fitted with either peak-top or straight cross-flights at suitable intervals.

The flights, filling practically the entire area of the casing within which they move, form a series of compartments that hold material.

Operation of the chain and flights within the casing causes material to be conveyed to the discharge point. Openings for feed access and discharge are provided in casing.

It is a book that should be in the reference library of every engineer, purchasing agent and works manager concerned with the mechanical handling of bulk flowable granular, crushed, ground or pulverized materials.

Ask for a copy of new Bulk-Flo Book No. 2175, and address your request either to Bulk-Flo headquarters—Link-Belt Co., 2410 West 18th St., Chicago 8, Ill., or to the nearest Link-Belt office.

• Keep Informed

Green-Vegetable Packing Equipment Book Published by Link-Belt

A new 8-page Book No. 2073 illustrating and describing green-vegetable packing, handling and icing methods, has been published by Link-Belt Co., Chicago, San Francisco.

Ice crushers and pulverizers; ice crusher-slingers for "top-icing" long-haul shipments of green vegetables; conveyors for vegetables, culls, crates, block ice, crushed ice; and a complete line of power transmission machinery, are the featured items.

Packing shed operators, shippers and other interested readers may obtain a copy of new Book No. 2073 by writing to the nearest office of Link-Belt Co.

New C. Lee Cook Piston Ring Catalog

The C. Lee Cook Manufacturing Co., Louisville, Ky., announces the publication of a new 36-page catalog No. 470 fully describing the complete line of Cook Graphitic Iron Piston Rings for industrial size Diesels and compressors.

The catalog gives details on ring design and construction, ring service and ring specifications. Included are engineering tables, diagrams and data as well as practical suggestions relative to the ordering of piston rings.

Copies are available to design and operating engineers who write for it on their business letterhead direct to the company's General Sales Office, 76 Beaver Street, New York 5, N. Y.

New Line of Rotojet Tube Cleaners

The complete new line of Rotojet Tube Cleaners manufactured by the Elliott Co., Roto Division, 157 Sussex Ave., Newark, N. J., is described and illustrated in a new bulletin just off the press. The company claims that the power, efficiency, and cleaning speed of its new Rotojet Tube Cleaners greatly exceed any produced during its 38 years of specialization in the manufacture and sale of tube cleaners. Also shown in the new bulletin are various types and sizes of Rotojet Motors for operation with water, compressed air, and steam. Parts and accessories illustrated, include various types of heads, air valves for one-man operation, lubricators, and hose. Tables list sizes and types of tubes, and specify the Rotojet Tube Cleaner recommended for each.

Edward Issues New Bulletin on Intex and Univalves

East Chicago, Ind.—A New Edward catalog section describing forged steel chrome-molybdenum Intex and "Univalves" has been issued by Edward Valves, Inc., East Chicago, Ind.

Univalves are welded bonnet integral seat valves for service at 1500 and 2500 lb at 1000 F. Intex valves are bolted bonnet integral seat valves rated at 1500 lb, 1000 F.

Bulletin gives details of construction, dimensional and design data, material specifications and other data.

Steam Jet Ejectors

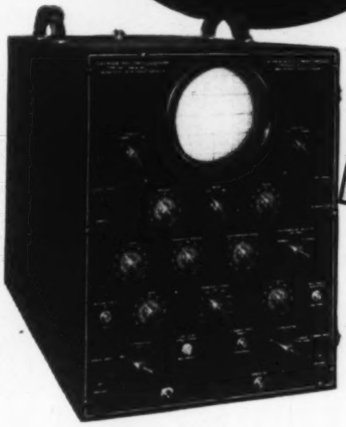
C. H. Wheeler Manufacturing Co., 1730 Sedgley Ave., Philadelphia, Pa., announces a new catalog, Number 1462, entitled "Steam Jet Ejectors," which has just come off the press.

This catalog contains 36 pages and includes 30 sectional drawings—also flow diagrams, engineering data, installation

Continued on Page 60

How a Mechanical Problem was solved by

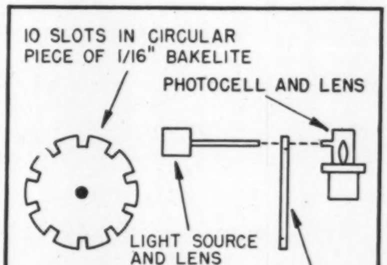
CATHODE-RAY Oscillography



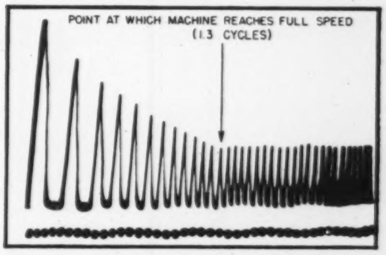
The Problem: Determining starting characteristics of high-speed machine—number of cycles of motor and elapsed time for machine to reach full speed.

Tools and Method: Standard Du Mont Type 247 Cathode-ray Oscillograph, one circular disk with ten slots, photo-cell, source of light.

The Solution: Disk attached to drive shaft of machine. Disk interrupts light beam. For every revolution ten light pulses produce ten electrical pulses in photo-cell. By suitable circuits and timing markers (at 500 cps), pulses are shown as varying amplitudes. Oscillogram is visual solution of problem.


10 SLOTS IN CIRCULAR PIECE OF 1/16" BAKELITE
PHOTOCELL AND LENS
LIGHT SOURCE AND LENS
SLOTTED DISC (ATTACHED TO MAIN SHAFT OF MACHINE)

Interpretation of Oscillogram: Twenty-three 500-cycle markers can be counted from time machine starts until it reaches full speed. Twenty-three markers equal 46 milliseconds. Since ten pulses are equivalent to one revolution of machine, 13 pulses equal 1.3 cycles per revolution. Therefore, 1.3 cycles and 46 milliseconds are required for machine to reach full speed.



The foregoing mechanical problem is but one of many solved by Du Mont Oscillography. And remember, Du Mont has a complete line of oscillographs applicable to all kinds of mechanical engineering needs. For example: The new Polar-coordinate Indicator is particularly suited to study of rotating or reciprocating devices. Why not inquire into the possibility of applying a Du Mont oscillograph to your particular requirements?

DUMONT

ALLEN B. DU MONT LABORATORIES, Inc.
Passaic • New Jersey
Cable Address: Albeedu, Passaic, N. J., U. S. A.

guide, formulae, curves and tables. It covers the theory and operating characteristics of steam jet ejectors for all classes of vacuum service, including single, two, three, four and five stage types. Non-condensing and condensing types, with barometric inter-and-after-condensers for vacuum requirements in chemical plants, food plants, sugar refineries, oil refineries, power plants, etc., are fully covered. It also contains information regarding steam jet vacuum refrigeration for water cooling requirements of air conditioning and process applications.

Modern Equipment for the Transmission of Power

A new 16-page brochure has been prepared by the T. B. Wood's Sons Co., of Chambersburg, Pa. It describes briefly and illustrates profusely the manufacturing facilities of this pioneer producer of Modern Equipment for the Mechanical Transmission of Power.

New Rotameter Catalog

Schutte & Koerting Co. announce a new 36-page Bulletin, 18-R, covering SK Totameters, Specific Gravity Indicators and Flow Indicators. Text, illustrations, drawings and photographs describe the various regular and special SK Rotameters. Also described are several types of SK Flow Indicators, Specific Gravity Indicators, Flow Alarms, and related equipment.

Among the Rotameters included are several Chemical Rotameters, for service under corrosive conditions; Armored Rotameters for severe high pressure uses; Sanitary Rotameters for food products; Electronic Rotameters which measure and continuously record rate of flow.

There is a complete section explaining SK Rotameters in general and their method of operation; mathematical formula for this operation is derived in another part of the Bulletin. New tables permit easy selection of correct Rotameter for a specific application, either fluid or gas.

Copies may be obtained by writing for Bulletin 18-R to Schutte & Koerting Co., 1166 Thompson Street, Philadelphia 22, Pa.

Welding Fittings

Taylor Forge Bulletin 476, Stainless Steel Dimensional Data, describes welding fittings from three-quarter inch to 12 inches, and light-weight American Standard flanges from three-quarter inch to 30 inches, all available in stainless types 304, 316 and 347, monel, inconel, nickel, copper and other usual industrial metals. Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.

Westinghouse Announces Booklet Describing Axiflo Fans

An eight-page color booklet describing the economic and versatile performance of the new line of Westinghouse Axiflo fans suitable for high temperature applications has been released by the Westinghouse Electric Corp.

Especially significant in the design is the low resistance cone housing that keeps the motor, belts, and all bearings out of the air stream, thereby introducing a great variety of high-temperature applications never before possible with conventional fans.

Complete with pictures of the various models available in either the elbow or straight-through type, the booklet describes how the unique cone arrangement and other features including low maintenance and ease of installation make these positive pressure fans suitable for such applications as air conditioning systems, heating and ventilating, dust and fume removal, equipment and machinery cooling, heat treating nonferrous metals, and industrial drying and processing.

To provide a wider range of operating conditions, Axiflo fans are available with either three-bladed aluminum alloy or eight-bladed welding steel fan wheels. Characteristics and special advantages of each are listed.

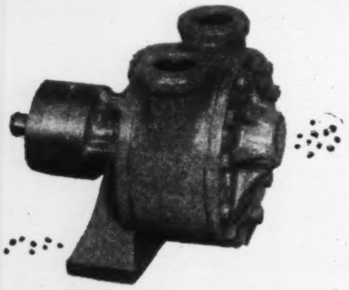
Copies of the booklet (B-3804) may be obtained from the Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

Alloy Steel Dowel Pins

Standard Pressed Steel Co. of Jenkintown, Pa., manufacturers of the well-known "Unbrako" Screw Products, announce the addition of a line of high-grade alloy steel dowel pins. Bulletin which describes the new product and gives pertinent data about it is available.

High Vacuum Apparatus

The Central Scientific Co., 1700 Irving Park Road, Chicago 13, Ill., have just issued a new booklet on their various high vacuum apparatus. Included in this 48-page pamphlet are suggestions for planning a high-vacuum system; information on pumping speed; explanation of merit factor, connections and speed of evacuation, low pressure technique, and other data, together with a complete listing of Cenco mechanical pumps, D-P diffusion pumps and Cenco gages, oils, traps and other vacuum accessories. Write attention Dept. M. E. for copy of Bulletin No. 10 on high vacuum equipment.



A COMPACT PUMP *For Your High Pressure Needs . . .*

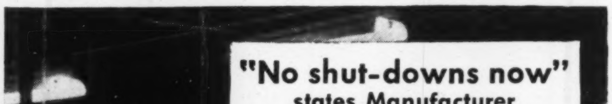
by TUTHILL

To save space, material and money in high pressure service for hydraulic mechanisms and other industrial machinery, specify Tuthill Model CK internal-gear rotary pumps. These compact, dependable pumps are furnished in capacities up to 50 g.p.m. and pressures up to 400 p.s.i. Direct motor drive, V-belt units and integral drives.

Write for Model CK bulletin

TUTHILL PUMP COMPANY

939 East 95th Street • Chicago 19, Illinois



"No shut-downs now"
states Manufacturer
since installing
GITS
MULTIPLE
OILERS

Atlas-Boxmakers, Inc., Chicago, Ill., writes: "Wish to commend you on the quality of your automatic multiple oilers. Prior to their installation on our . . . press, at least once each day the press would freeze due to insufficient oil. Since the installation of these oilers the press has not been shut down at any time due to lack of oil to the component parts fed by your multiple oilers."

Manufacturers everywhere are installing GITS centralized oiling systems—for guaranteed lubrication and reduced maintenance. Let us tell you this GITS story!

Write for 166-page catalog

GITS BROS. MFG. CO.

1837 S. Kilbourn Ave., Chicago 23, Illinois

Exclusive for over 40 years

Kodak

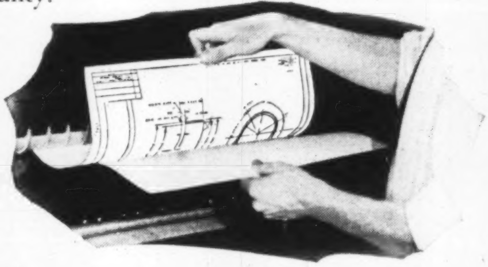
Here's what

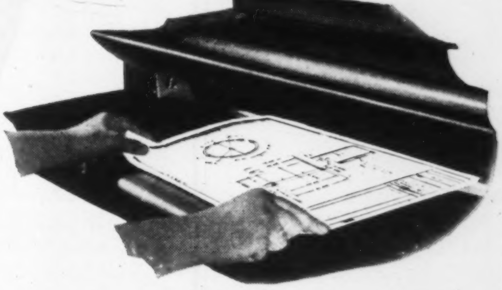
Kodagraph Autopositive Paper—

THE BIG NEW PLUS

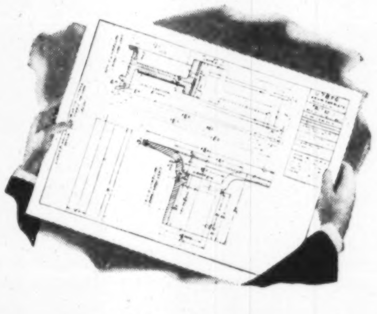
—brings to engineering drawing reproduction

PRINTS POSITIVES DIRECTLY! With this revolutionary new Kodagraph Autopositive Paper that prints direct to positive . . . without the negative step . . . in ordinary roomlight . . . any well-equipped reproduction department can produce masters and prints of unsurpassed quality.





PHOTOGRAPHIC MASTERS—With Kodagraph Autopositive Paper, photographic masters of new tracings—masters with the printability and durability that photography alone assures—can now be made on direct process and blueprinting machines.



HIGHEST QUALITY DISTRIBUTION PRINTS—From masters made on Kodagraph Autopositive Paper, quantity direct process and blueprints can be made that are the last word in legibility . . . better than prints from the original drawing.

Eastman Kodak Company
Industrial Photographic Division
Rochester 4, N. Y.

MAKES "UNPRINTABLE" ORIGINALS PRINTABLE . . . even old, worn, torn, stained, or opaque originals can be reproduced on direct process and blueprinting equipment. Truly revolutionary . . . this new Kodagraph Autopositive Paper. To brief your people on it, write for booklet.

FREE—Kodagraph Paper booklet

THE BIG NEW PLUS

Eastman Kodak Company
Industrial Photographic Division
Rochester 4, N. Y.

Please send me a copy of "The Big New Plus"—your booklet about Kodagraph Autopositive Paper, and the other papers in this new Kodak line. I have ☐ direct process ☐ blueprint ☐ contact printer equipment.

Name____________________ (please print)

Department____________________

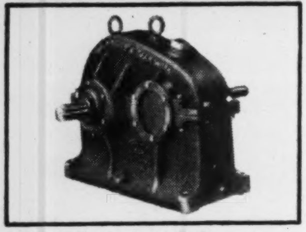
Company____________________

Street____________________

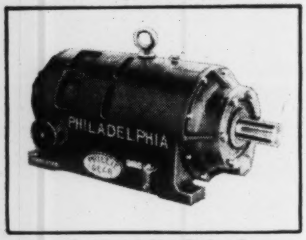
City____________________State__________

THESE PHILLIE GEAR REPRESENTATIVES

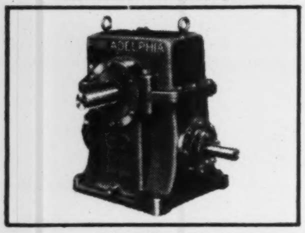
are always ready to help you . . .



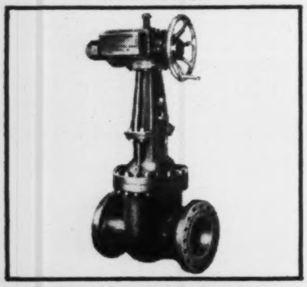
Herringbone Reducer



Horizontal MotoReduceR



Worm Reducer



Limitorque Valve Operator

DISTRICT SALES OFFICES

Chicago, Illinois
111 West Washington St.

New York 18, N. Y.
330 W. 42nd Street

Pittsburgh, Pa.
418 Frick Building

SALES REPRESENTATIVES

AKRON, OHIO
John F. Beese
Akron Savings and Loan Bldg.

ATLANTA, GEORGIA
A. J. Kroog
902 West College Avenue
Decatur, Georgia

BOSTON, MASS.
Mills Engineering Company
10 High Street

BUFFALO, NEW YORK
H. E. Sundberg
Ellicott Square Building

CHICAGO, ILLINOIS
Philadelphia Gear Works, Inc.
A. R. Herbert, Manager
111 West Washington Street

CHICAGO, ILLINOIS
H. J. Kaufman
20 North Wacker Drive
(Limitorque only)

CLEVELAND 3, OHIO
J. D. Ingram
4500 Euclid Avenue

DALLAS, TEXAS
Lynn Elliott Company
Mr. Ralph Eads
607 Construction Bldg.

DETROIT, MICHIGAN
L. L. Handy
6432 Cass Avenue

HOUSTON, TEXAS
Lynn Elliott Company
322 M & M Building

INDIANAPOLIS, INDIANA
A. R. Young
635 North Pennsylvania Street

KANSAS CITY, MISSOURI
L. C. Pensinger & Son
1332 Oak Street
(Limitorque only)

LOS ANGELES 21, CALIFORNIA
L. F. Atwood
695 Santa Fe Avenue

MILWAUKEE, WISCONSIN
Roy C. Kendall
437 Commerce Building
744 North Fourth Street

MINNEAPOLIS, MINNESOTA
F. M. Giefer
2644—34th Avenue South

NEW ORLEANS 18, LA.
Walter B. Moses, Jr.
7836 Saint Charles Avenue

NEW YORK 18, NEW YORK
Philadelphia Gear Works, Inc.
Mr. J. K. Rewalt, Manager
330 West 42nd Street

NEWARK, NEW JERSEY
C. W. Ludlow
572 Highland Avenue

NORFOLK 10, VIRGINIA
R. T. Overstreet
522 Wainwright Building

OAKLAND 7, CALIFORNIA
P. E. Haultain
239–241 12th Street

PITTSBURGH, PENNSYLVANIA
Philadelphia Gear Works, Inc.
Mr. George Nairn, Jr., Manager
418 Frick Building
5th Avenue and Grant Street

PITTSBURGH, PENNSYLVANIA
Herr-Harris Company
Room 1101—545 Wm. Penn Way
(Limitorque only)

PORTLAND, OREGON
W. G. Ballantyne Company
1215 N. W. Everett Street

ST. LOUIS, MISSOURI
Kingsley Davey
713 Ambassador Building
411 North 7th Street

SAN FRANCISCO, CALIFORNIA
Merrill Company
Hobart Building
582 Market Street
(Limitorque only)

SEATTLE, WASHINGTON
W. G. Ballantyne Company
S. F. Patterson
1717 West Austin Street

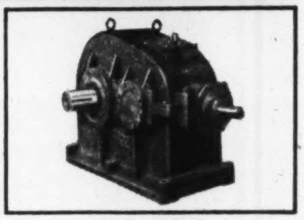
SYRACUSE, NEW YORK
Uplinger and Sherman Inc.
600–604 South West Street

TULSA, OKLAHOMA
H. A. Rogers
717 Daniel Bldg.
3rd Street and Boston

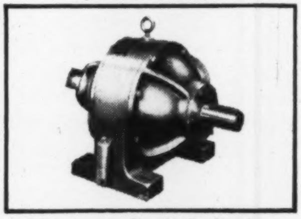
•

TORONTO, ONTARIO, CANADA
William & J. G. Greey Ltd.
56 Esplanade Street

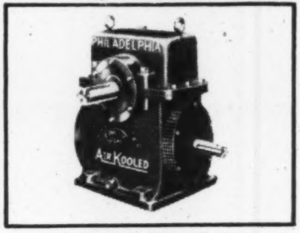
SAGUA LA GRANDE, CUBA
Fundicion Macfarland, S. A.



Spiral-Bevel Reducer



Planetary—Single Reductions



"AirKooled" Worm Reducer

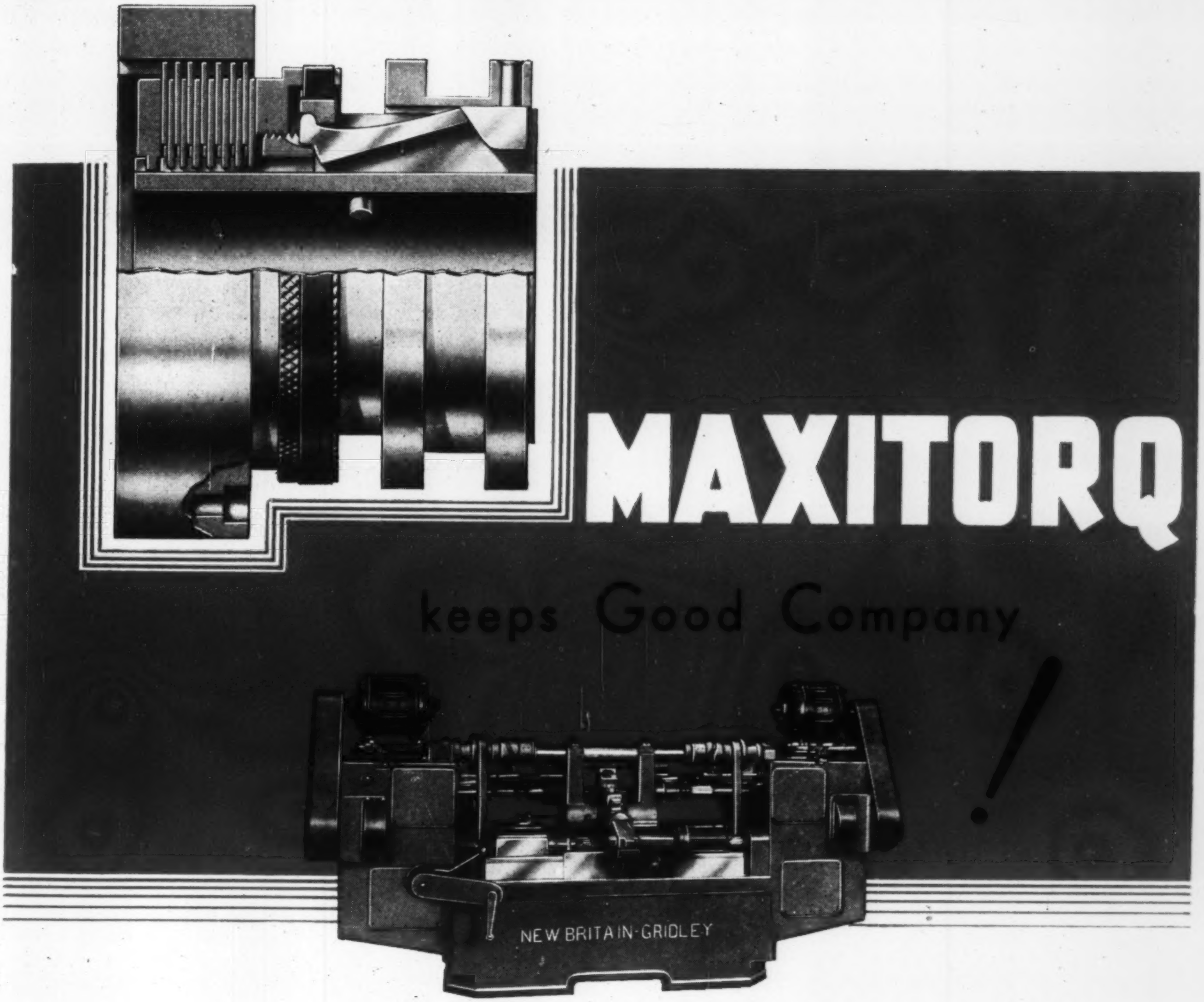
Vertical MotoReduceR

. . . they're a vital part of "Phillie Gear's" nationwide service to Industry.

Philadelphia
GEAR WORKS INCORPORATED
ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

NEW YORK • PITTSBURGH • CHICAGO . . . IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO



THE MAXITORQ Floating Disc Clutch was designed to solve certain power transmission problems, especially those formerly encountered in automatic machine tool operation. As evidence that MAXITORQ design has proven successful we show the new Double End Tool Rotating Chucking Machine, manufactured by New Britain-Gridley Machine Division.

Normally two single clutches are used in this model . . . one to control feed motions, the other for control of the rapid transverse. When threading is done, at either or both ends of the machine, one double clutch serves each spindle.

May we suggest that Designers and Manufacturers of machine tools, and other machinery, ask for our detailed bulletin. It contains information you need . . . about the clutch you can use . . . profitably.

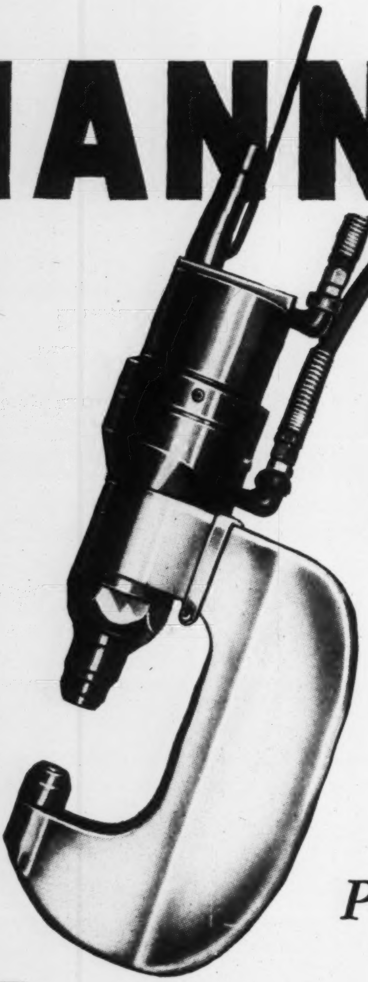
Send for Catalog No. ME2

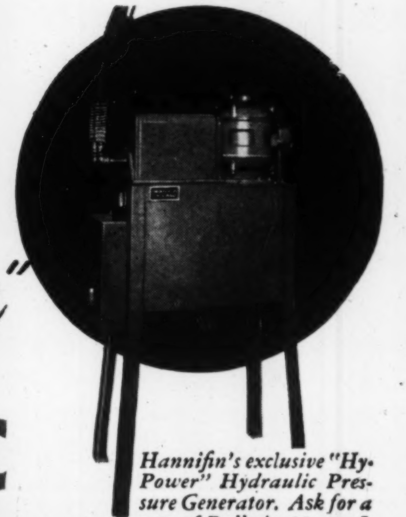
Let's talk
MAXITORQ

ICJ48

THE CARLYLE JOHNSON MACHINE COMPANY
MANCHESTER • CONNECTICUT

HANNIFIN "hy-power" HYDRAULIC UNITS FOR

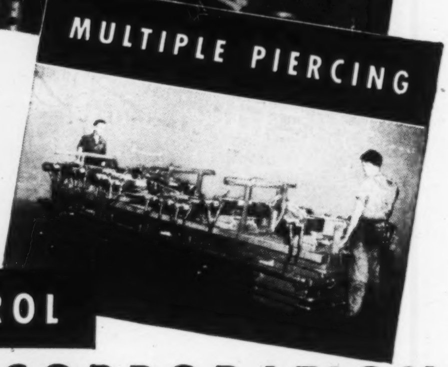




Hannifin's exclusive "Hy-Power" Hydraulic Pressure Generator. Ask for a copy of Bulletin No. 53-L.

RIVETING

PRESSING



MULTIPLE PIERCING

FAST!
EFFICIENT!
PORTABLE!

FOR prompt, dependable help in getting tooled up for efficient production, use Hannifin "Hy-Power" Hydraulic Units.

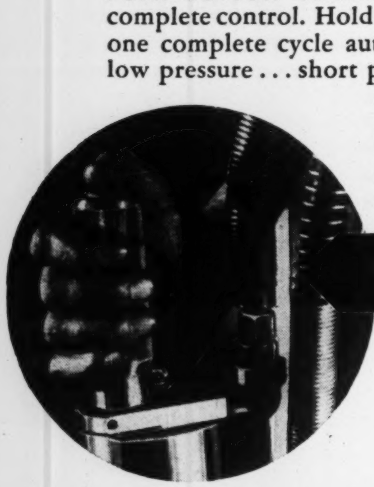
COMPLETE LINE—Portable and stationary types. Standard and special designs available for riveting, pressing, punching, piercing, crimping. Dies for every purpose. Capacities to 100 tons; reach to 6′ or more.

FAST—Time cycle for standard riveters ranges from 1½ seconds to 3 seconds for 3″ or 4″ stroke units.

EFFICIENT—More work with less effort, no noise. Easy to maintain almost unbelievably high production rates. Low power costs. Every operating convenience.

PUSH BUTTON CONTROL—A single push button* gives you complete control. Hold button down and riveter goes through one complete cycle automatically: rapid advance stroke at low pressure . . . short power stroke at full pressure . . . automatic return to starting position. To repeat cycle, release and again depress button. For instant safety at any point, release button and ram retracts.

*Foot control also available.



PUSH BUTTON CONTROL

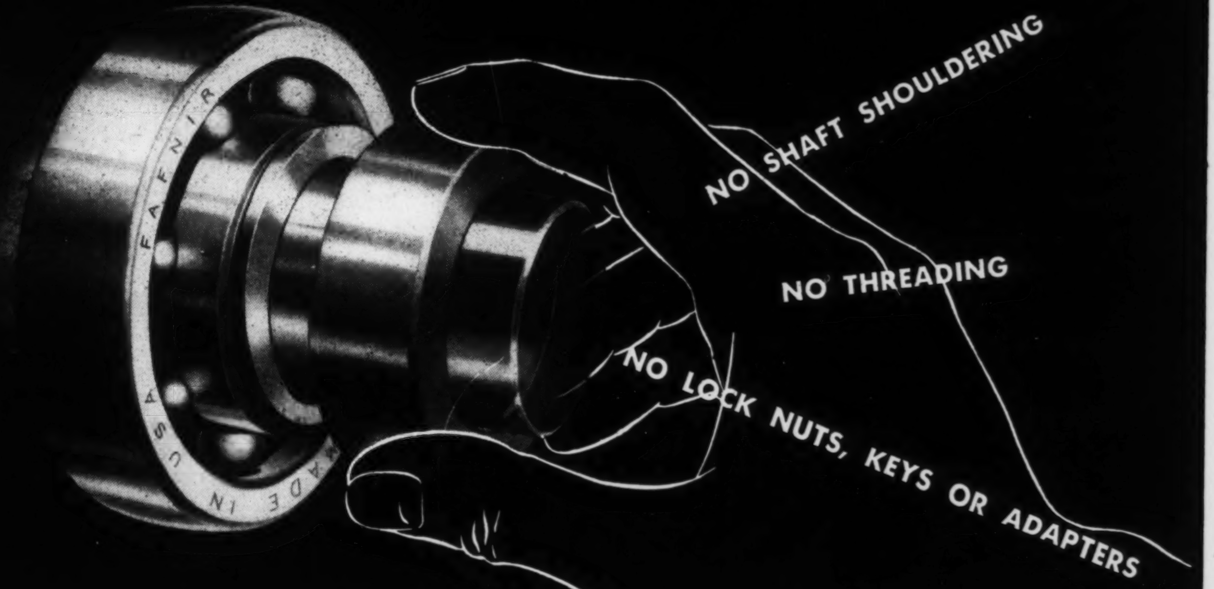
HANNIFIN CORPORATION

1101 S. Kilbourn Ave. HANNIFIN Chicago 24, Illinois

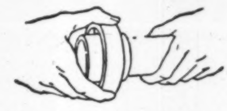
AIR CYLINDERS • HYDRAULIC CYLINDERS • HYDRAULIC PRESSES
PNEUMATIC PRESSES • HYDRAULIC RIVETERS • AIR CONTROL VALVES

Nationwide Sales and Service

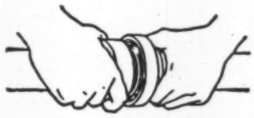
EASIEST TO INSTALL . . . and remove


NO SHAFT SHOULDERING
NO THREADING
NO LOCK NUTS, KEYS OR ADAPTERS
FAFNIR
MADE IN U.S.A.

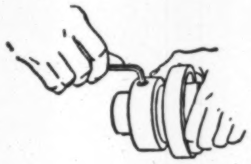
FAFNIR Wide Inner Ring Ball Bearing with the self-locking collar



SLIP IT OVER THE SHAFT

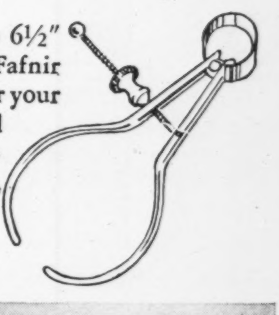


ENGAGE AND TURN THE COLLAR



SET THE SCREW — BEARING IS SECURED TO THE SHAFT

For standard shafts . . . from ½″ to 6½″ . . . built into a complete line of Fafnir Power Transmission Units or adaptable for your own housing. Available from authorized Fafnir Distributors located in all principal cities. The Fafnir Bearing Company, New Britain, Conn.

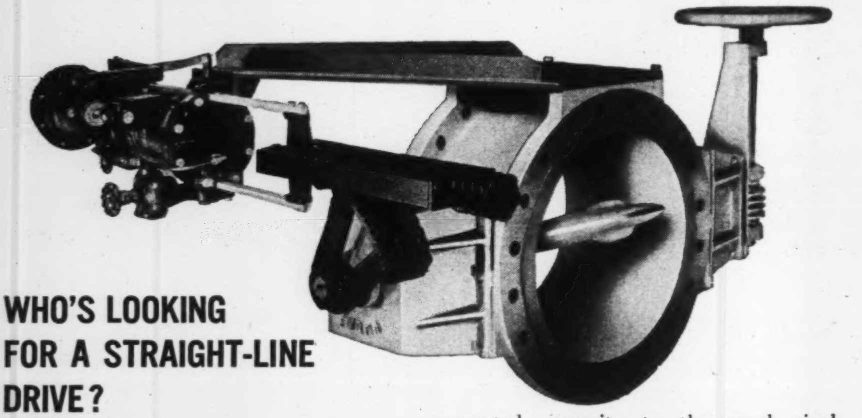


FAFNIR
BALL BEARINGS

MOST COMPLETE LINE IN AMERICA

R-S valvEvents

ISSUED PERIODICALLY BY R-S PRODUCTS CORPORATION, PHILADELPHIA 44, PA., FOR THOSE CONCERNED WITH FLOW CONTROL AND SHUT-OFF



WHO'S LOOKING FOR A STRAIGHT-LINE DRIVE?

Constant 90° angularity between the prime mover and the valve stem . . .

Since 1943 the R-S Type 602 valve has had great success in the service of our customers who want Straight-line drive.

The picture shows a 24-inch 150-pound R-S Cast Steel valve with Series 15 raised face flanges and air-cylinder positioner. Hydraulic cylinders and air diaphragm motors, with or without positioners, are also available. They operate through a chain and sprocket providing straight-line action and eliminating compensation for angularity of bell-crank arm.

The valve pictured is provided with dual stuffing-boxes which cause the vane to "float" regardless of working pressure in the line. The handwheel and declutching unit for manual control are mounted opposite to the mechanical control side of the valve.

These R-S valves are available in all sizes for many temperature and pressure ranges.

R-S ESTABLISHES NEW ELECTRONIC DIVISION

To thoroughly inform its Valve Division representatives, who will handle the line, on the products and developments of its newly established Electronic Division, R-S Products Corporation recently called two special conferences. A Western group met at Chicago and the Eastern group at the company's plant in Philadelphia.

The Electronic Division is under the direction of David W. Hopkins, Executive Vice President of the company, and under the immediate management of Donald C. Culver, Ch.E. Culver, a graduate of Lehigh University, is an experienced physicist in the instrument and electronic field.

A new product of the Electronic Division is a unit for the control of fluid level, pressure and temperature, (R-S Catalog No. 27) called the Leveltronic, or Level Control.

JMLco P-AA2

R-S Appoints New Representatives

Latest appointments to the growing list of R-S Valve Representatives are:

Los Angeles: W. J. Beckett, 108 West Sixth Street, Los Angeles 14, handling Southern California. Phone Vandyke 2914.

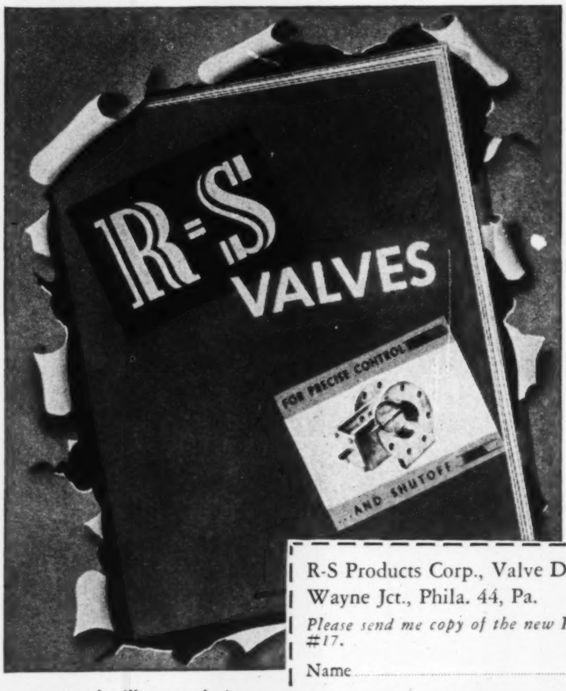
San Francisco: Merrill Company, 502 Market Street, San Francisco, handling Northern California. Wm. H. Edis is in charge of the Merrill organization. Phone Sutter 1-8280.

Knoxville: L. W. Oakley Sales Engineers, 408 West Church Avenue, Knoxville 10, Tennessee. The Oakley organization covers Tennessee, with offices also in Chattanooga and Johnson City.

Birmingham: Harry G. Mouat, 544 American Life Building, Birmingham 3, Alabama; covering Alabama and West Florida.

Santiago: Garrido, Garcia Burr & Co., Calle Central 40, Santiago, Chile.

Send for YOUR copy of the NEW R-S Valve Catalog No. 17!



Fully descriptive, generously illustrated; includes *complete* dimensional data on *all* R-S Valves. Write, wire, or phone: R-S PRODUCTS CORPORATION, Wayne Jct., Phila. 44, Pa.

R-S Products Corp., Valve Division
Wayne Jct., Phila. 44, Pa.

Please send me copy of the new R-S Valve Catalog #17.

Name ____________________
Title ____________ Company ____________
Street ____________ Zone ______
City ____________ State ______

a new partner in creating

You Get Finest Prints From Your Dry Diazo Equipment With Helios Papers, Cloths, Film

Exclusive Erasing Feature!

Users of dry diazo positive reproductions frequently make drawing changes on transparent intermediate originals, rather than on original drawings. Such changes are easier and quicker on Helios† transparent prints, made on either of the amazing new K&E products—Helios Tracing Cloth or Helios Albanized* Paper—because you can actually erase image lines from them with an ordinary soft ink or typewriter eraser. No inconvenient, time-wasting eradicating fluids are needed.

A Complete Line!

You can make positive line reproductions—working prints on opaque Helios papers or cloth—*directly* from original drawings, layouts, letters, documents, forms. Or else you can save your originals and reproduce your positive line working prints *directly* from positive line intermediate originals, made on Helios transparent papers, cloth or films. These Helios materials are available in rolls or cut sheets and they can be printed and developed in the dry diazo process machine you are now using.

K & E Quality Guaranteed!

More than any other reproduction process for drafting room use, the manufacture of diazo process materials demands, from start to finish, the utmost chemical and technical skill. For this reason, a new K&E plant was established to manufacture *all* the image-forming components essential to Helios products. Helios Positive Printing, Dry Developing Reproduction Materials are offered to you with the assurance that they conform in every way to K&E standards.

Write to Keuffel & Esser Co., Hoboken, N. J. for samples to test on your own equipment, or ask your nearest K & E Dealer or K & E Branch for a demonstration. Once you've tried Helios, you will agree that it pays to *be positive with Helios!*

*Trade Mark

†Reg. U. S. Pat. Off.

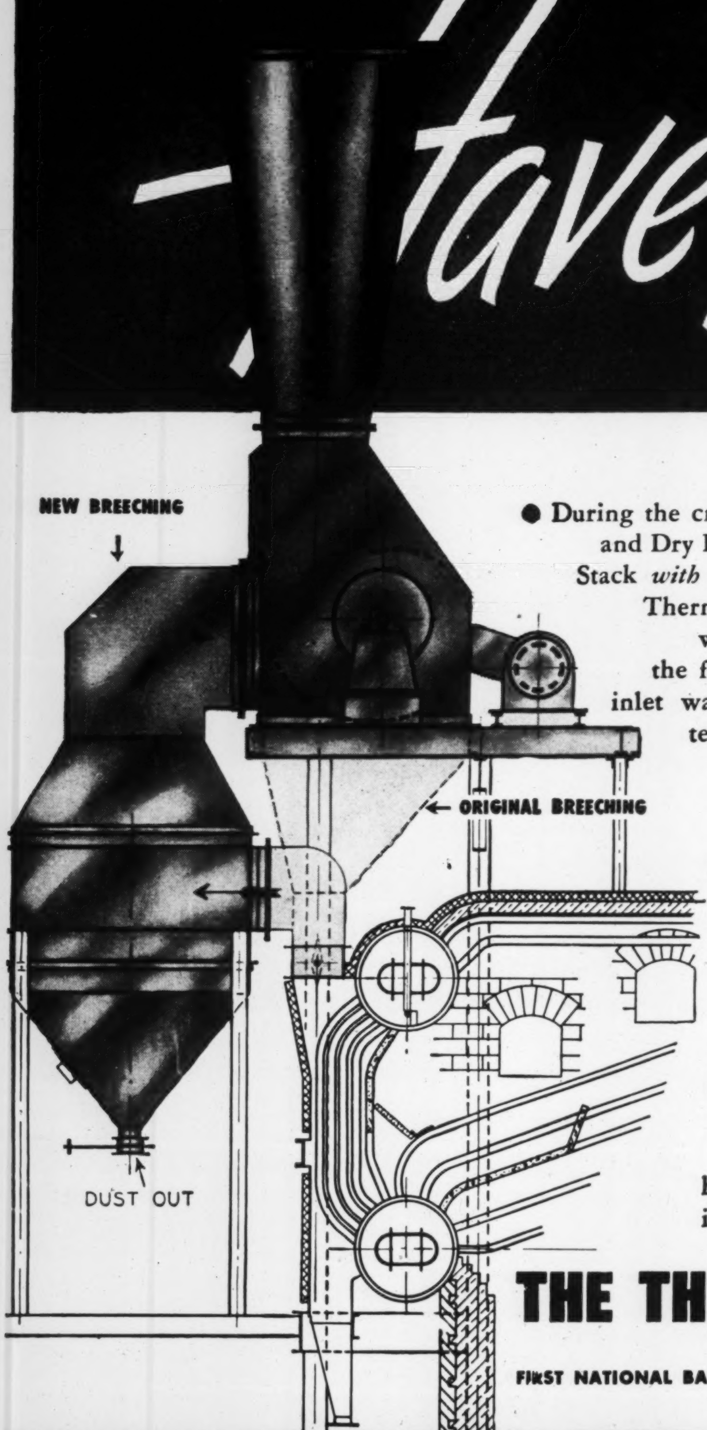
KEUFFEL & ESSER CO.
EST. 1867
NEW YORK • HOBOKEN, N. J.
CHICAGO • ST. LOUIS • DETROIT • SAN FRANCISCO
LOS ANGELES • MONTREAL

K+E
Drafting, Reproduction, Surveying Equipment and Materials, Slide Rules, Measuring Tapes.

The Federal Shipbuilding and Dry Dock Co.

ENGINEERED for the FUTURE

—Have You?



● During the critical shortage of steel, the Federal Shipbuilding and Dry Dock Company of New Jersey installed a Thermix Stack *with provisions for a dust collector at a future date.* A Thermix Fan Stack with both a side and bottom inlet was used. The side inlet was blanked off for use in the future installation of the dust collector; the bottom inlet was directly connected to the boiler outlet. This temporary breeching, from the boiler to the ID fan, is indicated in the illustration by dotted lines.

Now that steel is available, the Thermix Tubular Dust Collector has been added to the original stack installation. Placing it in operation necessitated only the removal of the duct from boiler to stack and connection of collector to boiler and side inlet of the fan. The original bottom inlet of the fan was then blanked off.

Thermix collectors have the distinct advantage of both flexibility and extremely high collection efficiencies over a wide range.

Call on our project engineers, the Thermix Corporation, for more detailed information on how your plant equipment can be designed and installed to permit future additions.

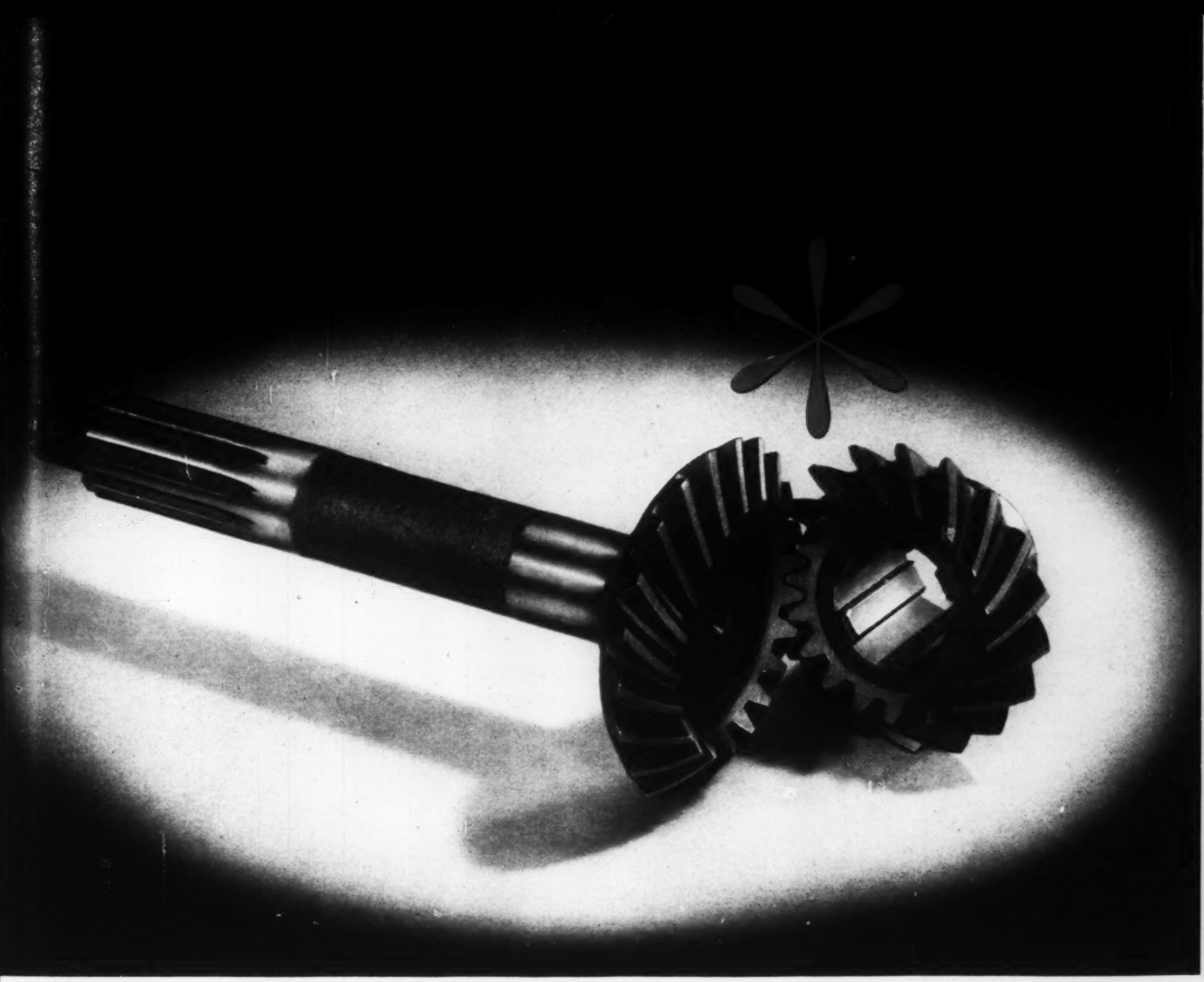
THE THERMIX CORPORATION

Project and Sales Engineers

FIRST NATIONAL BANK BLDG. GREENWICH, CONN.

PRAT-DANIEL CORPORATION

EAST PORT CHESTER, CONN.



* This Pair is prepared for "Better or Worse"

***These** are power take-off gears. Will they be called upon to idle along on easy jobs? Or will they be required to hit sustained top speeds under heavy gruelling loads? Who knows? With applications so varied in both industrial and agricultural fields they must be prepared for "better or worse"—designed and built to standards that anticipate the hardest possible service.*

In all likelihood the gears you use are expected to bear unusual loads or stand up under adverse operating conditions. When you have established ultimate load capacity, either in your own plant or with the aid of our engineers, you get Double Diamond Gears that *meet or exceed those specifications.* And that goes for every other requirement as well—speed, service life, quietness, tolerances, and the rest. In brief, you get the only kind of gears we care to make—gears in every way worthy of the Double Diamond trade-mark.

Another point worth your consideration: We've been making "Double Diamonds" for more than twenty-five years. That's of great importance in a business where yesterday's experience so often solves tomorrow's problems. If we can serve you, write.

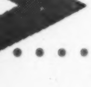
Made by
Automotive Gear Works, Inc.
RICHMOND, INDIANA

DOUBLE DIAMOND
TRADE MARK
GEARS

FOR AUTOMOTIVE,
FARM EQUIPMENT AND
GENERAL INDUSTRIAL
APPLICATIONS

HYPOID BEVEL

SPIRAL BEVEL


ZEROL BEVEL

FLYWHEEL GEAR

STRAIGHT BEVEL

STRAIGHT SPUR

HELICAL SPUR

SPLINED STEM PINION

SPLINE SHAFT

for MORE POWER

0
10
20
30
90
100
120
130
115V INPUT 50-60~
VARIAC
V20
VARIAC

● The Type V-20 VARIAC* with new materials and improved design delivers over 140 per cent more power per pound than its predecessor, the Type 100-Q. The V-20 is rated at 20 amperes, with a 30 ampere maximum; the V-20H, 8 amperes with a 10 ampere maximum.

These new VARIACS are provided with heavier barrier terminals in a box equipped with knockouts for standard ¾-inch BX or conduit. The new combination knob and handwheel makes it much easier to vary voltage. The V-20 dials have extra large calibration figures, easy to read at a distance.

As with all other VARIACS, output voltages are continuously adjustable from zero to 17% above line voltage.

SPECIFICATIONS

	TYPE V-20	TYPE V-20H
LOAD RATING (KVA)	3.45	2.3
Input Voltage	115	230 or 115
Output Voltage	Zero to 115 or 135	270 or 230
Rated Current (Amperes)	20	8
Maximum Current (Amperes)	30	10
PRICE	$55.00	$55.00

WRITE FOR THE "VARIAC BULLETIN"

*The trade name VARIAC is registered at the U. S. Patent Office. VARIACS are manufactured and sold under Patent No. 2,009,013.

GENERAL RADIO COMPANY Cambridge 39, Massachusetts

90 West St., New York 6 920 S. Michigan Ave., Chicago 5 950 N. Highland Ave., Los Angeles 38

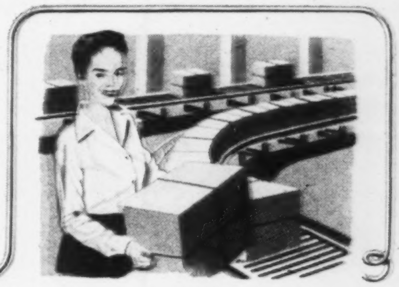
You'll be amazed at what can be made with Bundy Tubing!

Whether you make toys for tots, aerials for cars or garden tools for backyard putterers . . . Chances are, Bundy Tubing can help you do it faster, easier, cheaper and with a better, stronger product to boot.

PROOF . . . ? Right here, together with a hint of brand-new applications alert manufacturers will snap up *quickly!*

1 **Up pops** a youngster—brakes must work, though miles of shimmy and shake have tortured hydraulic lines. *That's why brake systems in 95% of today's cars use* strong, vibration-proof Bundyweld*—it's *double-walled* from a *single* strip.

2 **Mmmm . . . good!** Cooling devices in soda fountains (restaurants, bars, too) use Bundy Tubing for purity. Makers of beverage cooling coils are shifting to Bundyweld *nickel* because it's also fast cooling and easily fabricated.



3 **Bundyweld Tubing** shows up in most surprising places. Spacers between wheels in roller conveyors, for instance. Here, the close tolerance, uniform wall thickness and unusual strength of Bundyweld deliver the goods.

4 **Or how** about this? Television antennas of light, strong Bundy Tubing now pluck news and entertainment from the air. Weather-resistant Bundyweld is sag-proof, easily worked, ideal for rugged new uses with this great new industry.

5 **And there** are untapped possibilities. Sled runners, maybe. Strong permanently-round Bundy Tubing might be just the thing to give a kid the fastest sled on the hill . . . and to open up a gold mine for some foresighted manufacturer.

6 **Rake handles,** too. Or, what-have-you? There are probably hundreds, even thousands, of places where Bundyweld steel, Monel or nickel can go to work on a brand-new idea. Will *your* idea be one of these profitable possibilities?

7 **Many of today's** most successful Bundy Tubing uses were once nothing more than undeveloped ideas. Often Bundy engineers have helped to develop these ideas, through expert knowledge of the uses, structural and functional, which tubing can serve. Perhaps a Bundy engineer can help you with your idea. Call or write *Bundy Tubing Company, Detroit 14, Michigan.*

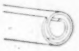
BUNDY TUBING

*REG. U.S. PAT. OFF.

ENGINEERED TO YOUR EXPECTATIONS ®

WHY BUNDYWELD IS BETTER TUBING

1 Bundyweld Tubing, made by a patented process, is entirely different from any other tubing. It starts as a single strip of basic metal, coated with bonding metal.



2 This strip is continuously rolled twice laterally into tubular form. Walls of uniform thickness and concentricity are assured by close-tolerance, cold-rolled strip.

3 Next, a heating process fuses bonding metal to basic metal. Cooled, the double walls have become a strong, ductile tube, free from scale, held to close dimensions.

4 Bundyweld comes in standard sizes, up to ⅝" O.D., in steel, Monel or nickel. For special sizes or tubing of other metals, call or write Bundy Tubing.

BUNDY TUBING DISTRIBUTORS AND REPRESENTATIVES:

Standard Tube Sales Corp.
76-01 Woodhaven Blvd.
Brooklyn 27, N.Y.

Peirson-Deakins Co.
823-824 Chattanooga Bank Bldg.
Chattanooga 2, Tenn.

Lapham-Hickey Co.
3333 W. 47th Place
Chicago 32, Ill.

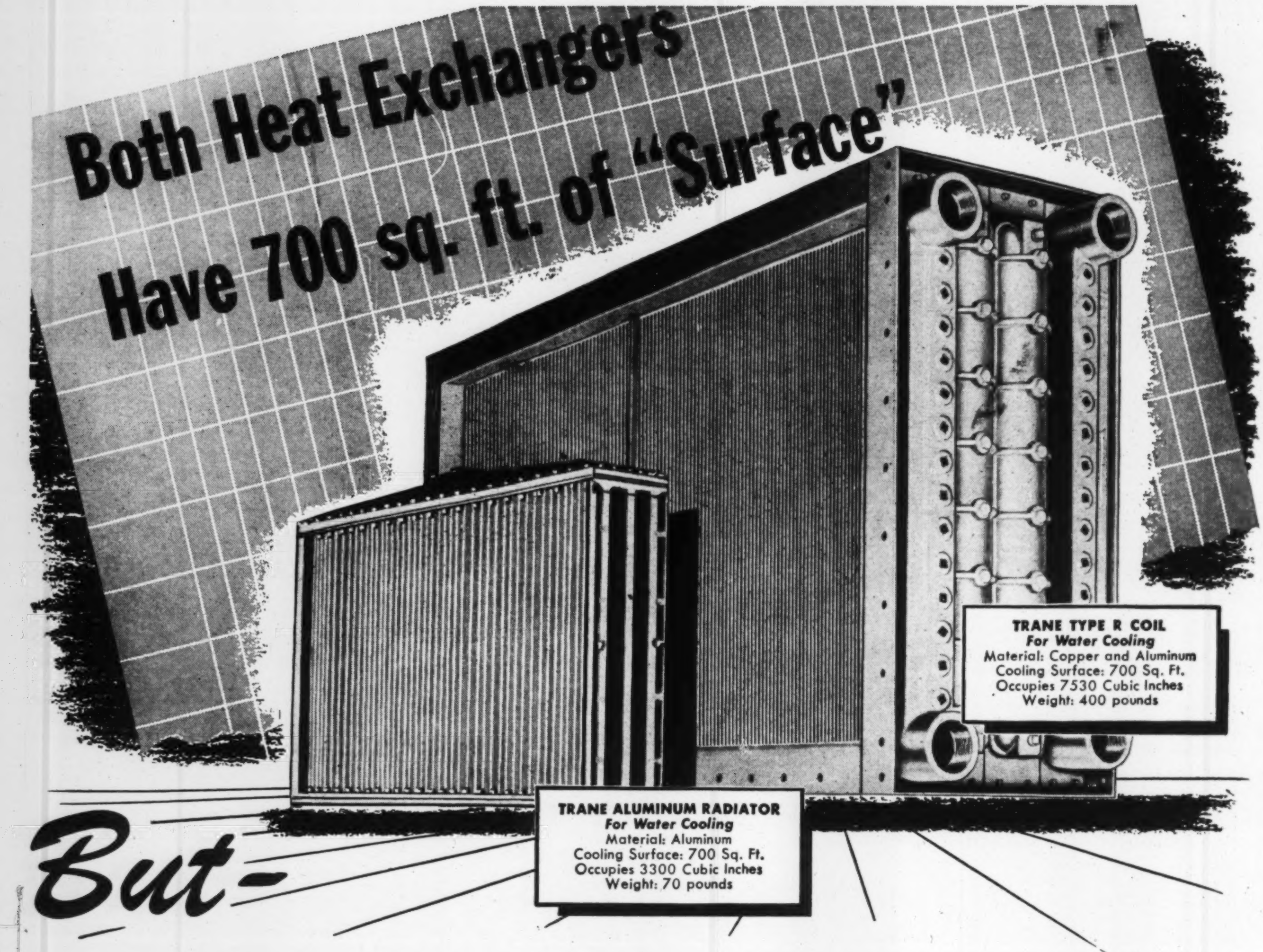
Rutan & Co.
404 Architects Bldg.
Philadelphia 3, Pa.

Pacific Metals Co., Ltd.
3100 19th St.
San Francisco 10, Calif.

Eagle Metals Co.
3628 E. Marginal Way
Seattle 4, Wash.

Alloy Metal Sales, Ltd.
861 Bay St.
Toronto 5, Canada

Bundyweld nickel and Monel tubing is sold by International Nickel Company distributors in all principal cities.


Both Heat Exchangers
Have 700 sq. ft. of "Surface"
TRANE TYPE R COIL
For Water Cooling
Material: Copper and Aluminum
Cooling Surface: 700 Sq. Ft.
Occupies 7530 Cubic Inches
Weight: 400 pounds
TRANE ALUMINUM RADIATOR
For Water Cooling
Material: Aluminum
Cooling Surface: 700 Sq. Ft.
Occupies 3300 Cubic Inches
Weight: 70 pounds
But-

One Occupies Less than Half the Space!

How TRANE Engineered Aluminum To Make it Possible

Making heat transfer surface in its familiar forms from aluminum has been commonplace with Trane engineers for many years. New machines and processes, however, called for even greater savings in space and weight than obtained by the mere substitution of aluminum in ordinary heat exchangers.

To develop a new lightweight surface, Trane engineers actually invented new techniques for the fabrication of aluminum . . . techniques that had been called impossible. For example, they developed a means for brazing paper-thin aluminum sheet in a flux bath. Even the designs of the new surface were complete departures from the ordinary. One result was the aluminum coil above that effects more than 50% saving in space and weighs only 1/6 as much as an ordinary coil.

Trane Engineering Ability Can Help You

Trane engineers apply this same ingenuity to the use of a wide range of metals in the design and fabrication of heat transfer surface. Where space, weight, or resistance to corrosion or pressure are problems, there may be Trane surface to do the job better.

For further information about Trane heat exchange surface—or about any of the most complete line of heating and air conditioning products in the industry—write The Trane Company for the location of the nearest of 85 Trane field offices.

TRANE

Manufacturing Engineers of Equipment for
HEATING AND AIR CONDITIONING

THE TRANE COMPANY, LA CROSSE, WISCONSIN • *Also* TRANE COMPANY OF CANADA, LTD., TORONTO, ONTARIO

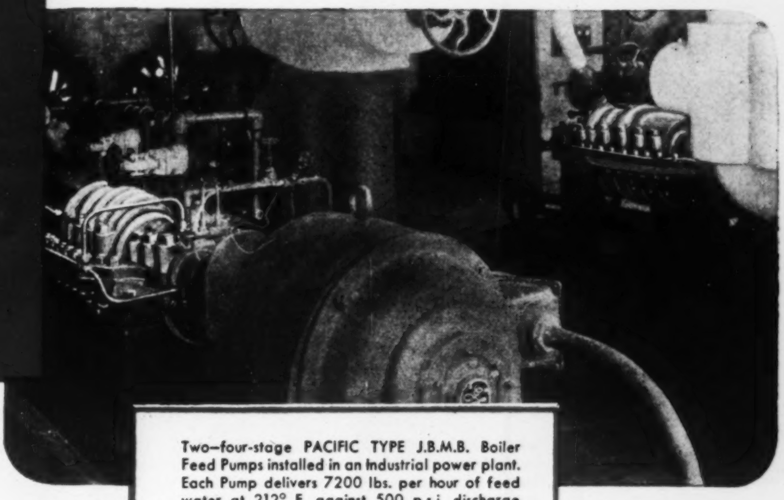
Your **PACIFIC**

TRIO

TYPES I-A-JB

Precision Built

For DEPENDABLE—UNINTERRUPTED BOILER FEED SERVICE IN POWER PLANTS—LARGE OR SMALL

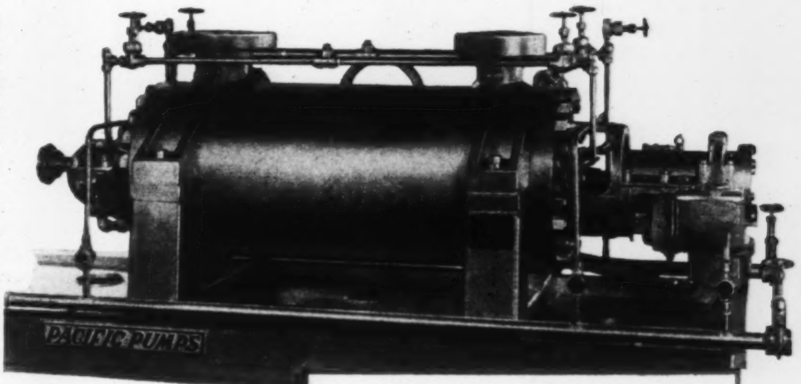


TYPE JB ➤ Two–four-stage PACIFIC TYPE J.B.M.B. Boiler Feed Pumps installed in an Industrial power plant. Each Pump delivers 7200 lbs. per hour of feed water at 212° F against 500 p.s.i. discharge pressure.

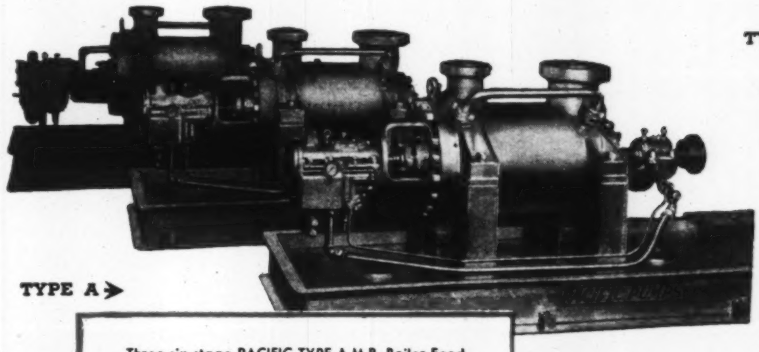
EXPERIENCE ★ For 23 years PACIFIC have designed and built centrifugal pumps for high-pressure–high-temperature service. The knowledge of this experience is incorporated in the PACIFIC TRIO–TYPES "I"–"A"–and "JB" Boiler Feed Pumps.

1925 ★ The first PACIFIC Centrifugal Pumps for High Pressure–4 units each for 180,000 lbs. per hour–175° F.–2100 p.s.i. discharge. Design featured RING TYPE JOINTS–METAL-TO-METAL SEAL to prevent interstage leakage, SUCTION PRESSURE on both Packing Boxes.

1925 to 1948 ★ a period of refinement. Included was the PACIFIC "Floating Seal"–a simple, effective pressure break-down and balancing device, making possible for PACIFIC in 1943 to build pumps to deliver 325,000 lbs. per hour of water at 545° F. against 1388 p.s.i. discharge pressure.



TYPE I ➤ One of four nine-stage PACIFIC TYPE I.M.B. Boiler Feed Pumps shipped in October 1947 for a large central station. Each pump to deliver 657,600 lbs. per hour of feed water at 220° F. against 1700 p.s.i. discharge pressure.



TYPE A ➤ Three six-stage PACIFIC TYPE A.M.B. Boiler Feed Pumps now being installed in a municipal power plant. Each pump to deliver 200,000 lbs. per hour of feed water at 287° F. against 1,000 p.s.i. discharge pressure.

DESIGN ★ embodies features proved in service –dynamic–radial and axial balance–ring-type high pressure joints–positive seal against interstage leakage–low pressure on Packing Boxes.

MATERIALS ★ the right materials for the service, Cast Steel Cases for medium pressures, forged Steel Cases for high pressures; (when necessary steel cases may be lined with 18-8). Interior parts fabricated from Chrome Alloy Steels to prevent erosion and corrosion.

APPLICATION ★ Pacific's Engineers are available to assist you in selecting from the PACIFIC TRIO the right pump for your service.

PACIFIC
Precision Built
PUMPS

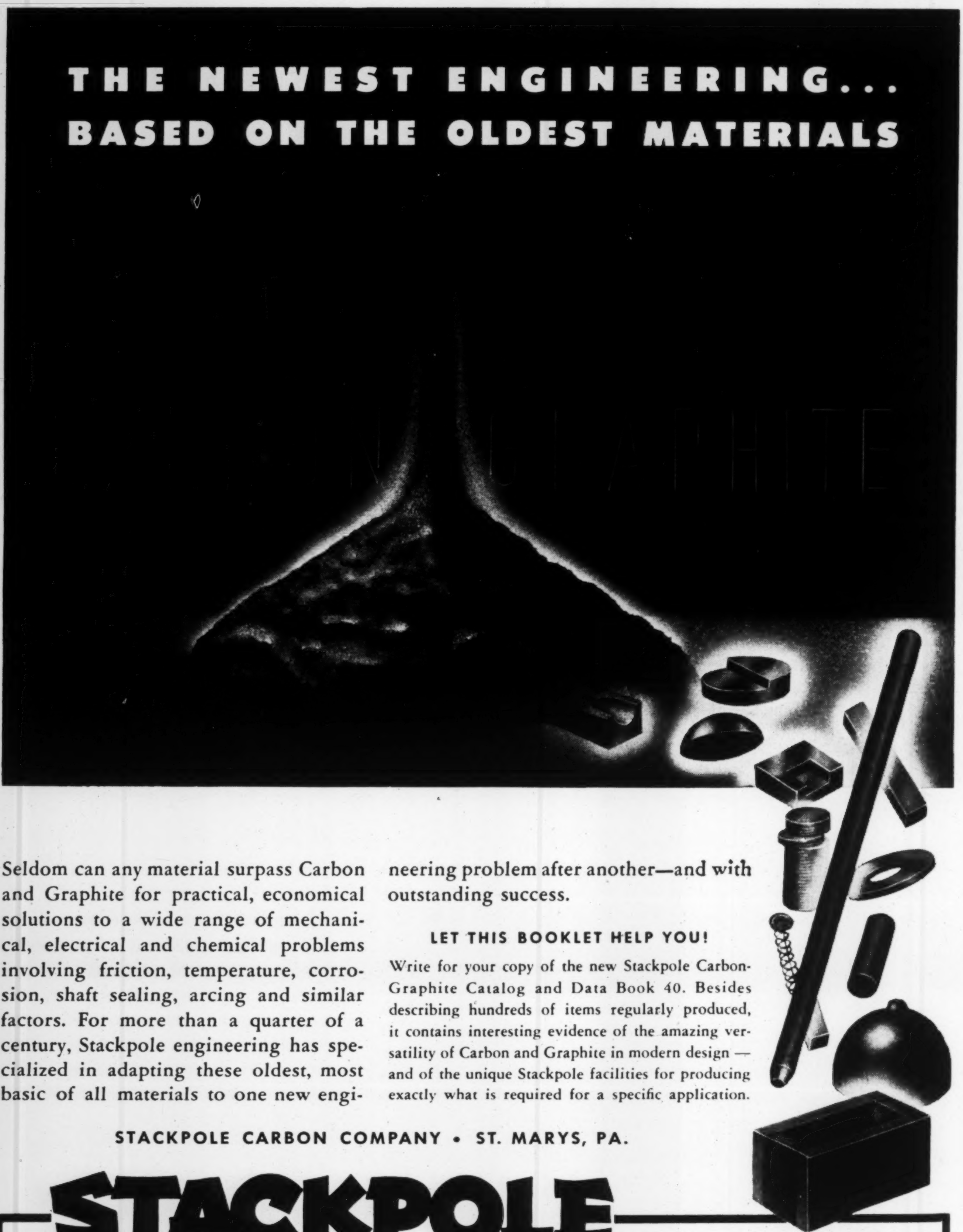
PACIFIC PUMPS INC.
HUNTINGTON PARK, CALIFORNIA

One of the Dresser Industries

BF-1

Offices in All Principal Cities—Export Office: 122 E. 42nd Street, New York City

THE NEWEST ENGINEERING... BASED ON THE OLDEST MATERIALS



Seldom can any material surpass Carbon and Graphite for practical, economical solutions to a wide range of mechanical, electrical and chemical problems involving friction, temperature, corrosion, shaft sealing, arcing and similar factors. For more than a quarter of a century, Stackpole engineering has specialized in adapting these oldest, most basic of all materials to one new engineering problem after another—and with outstanding success.

LET THIS BOOKLET HELP YOU!

Write for your copy of the new Stackpole Carbon-Graphite Catalog and Data Book 40. Besides describing hundreds of items regularly produced, it contains interesting evidence of the amazing versatility of Carbon and Graphite in modern design — and of the unique Stackpole facilities for producing exactly what is required for a specific application.

STACKPOLE CARBON COMPANY • ST. MARYS, PA.

STACKPOLE

CARBON GRAPHITE SPECIALTIES

BATTERY CARBONS • BEARING MATERIALS • BRAZING FURNACE BOATS • BRUSHES FOR ALL ROTATING ELECTRICAL EQUIPMENT • CARBON AND GRAPHITE CONTACTS • CARBON PILES (VOLTAGE REGULATOR DISCS) • CHEMICAL CARBONS • CLUTCH RINGS • CONTINUOUS CASTING DIES • DASH POT PLUNGERS • ELECTRIC FURNACE HEATING ELEMENTS • FRICTION SEGMENTS • GLASS MOLDS • MERCURY ARC RECTIFIER ANODES • METAL GRAPHITE CONTACTS • POWER TUBE ANODES • RAIL BONDING MOLDS • RESISTANCE WELDING AND BRAZING TIPS • SEAL RINGS (FOR GAS OR LIQUID) • SPECIAL MOLDS AND DIES • TROLLEY AND PANTOGRAPH SHOES • WATER HEATER AND PASTEURIZATION ELECTRODES • WELDING CARBONS, ETC. • ELECTROLYTIC ANODES.

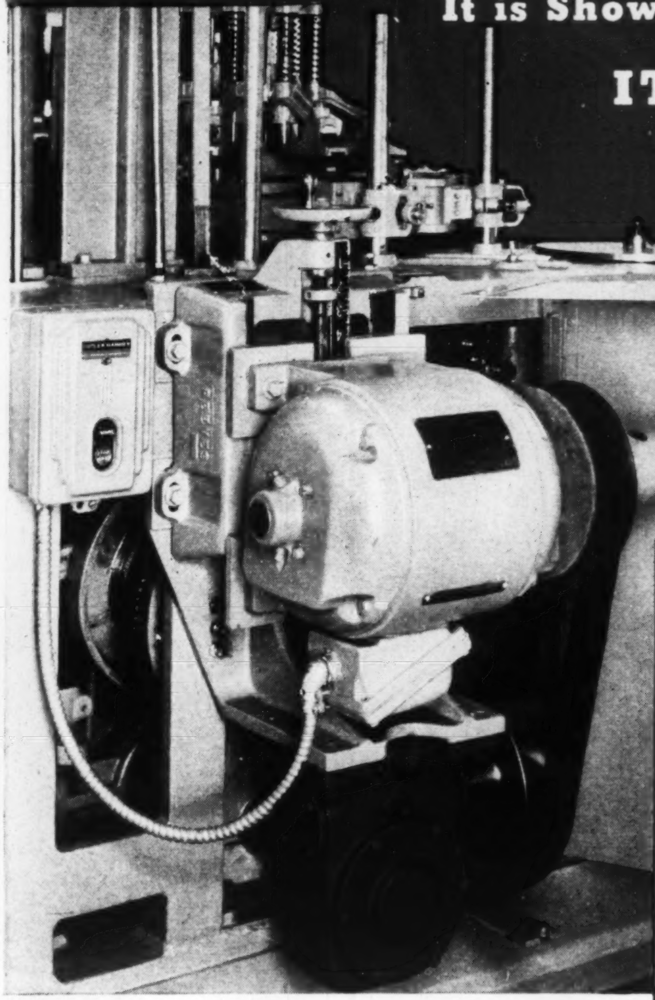
See How This SPEED REDUCER Stands Out

It is Shown in Red to Emphasize

IT IS OUTSTANDING

IT IS A GENUINE

WHS



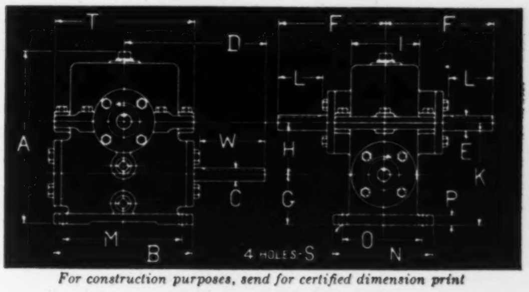
WINSMITH WHS SPEED REDUCERS

This close-up view of the drive on a "World Turret Labeler" made by Economic Machinery Co., Worcester, Mass., shows a ceiling-mounted No. 4½B WHS Worm Gear Speed Reducer, regular stock model. Dimensions are given in red at right.

This compact little reducer is a veritable "work-horse" . . . . known throughout industry for its dependability. The "B" Series is available in sizes from 1/5 H. P. to 12½ H. P. . . . and the trade-name from now on for this Series, as well as for all other units in the line, will be "WINSMITH".

Send for our pocket catalog No. 147 showing complete line.

"B" SERIES — Continued



For construction purposes, send for certified dimension print

"B" SERIES DIMENSIONS (in inches)

Unit	A	B	C	D	E	F	G
4B	8½	7	⅝	7⅛	¾	5⅜	2½
4½B	9⅝	8¼	¾	6¼	1¼	5⅜	3
5B	10¾	9⅝	1	8½	1¼	7	3⅛
5½B	15½	11¼	1	10¼	1⁷⁄₁₆	8½	5½
6B	14¾	12⅞	1	10⅛	1½	7¼	3¾
8B	18⅝	15⅜	1¼	12	2	9⅛	5
8½B	23	19	1⁷⁄₁₆	12⅝	2¾	9¼	6½
9B	28	20	1¾	15	3½	13¾	9

Unit	H	I	K	L	M	N	O
4B	2⅝	3½	5⅛	2¼	6	5	4
4½B	3	3½	6	2¾	7	6	4¾
5B	3½	4	6⅝	3	8⅛	6½	5⅛
5½B	4 6	4½	10 1	3¹¹⁄₁₆	8	11½	9
6B	5.167	4	8¹⁵⁄₁₆	3³⁄₁₆	8½	6½	5¼
8B	6½	5¼	11½	4⅛	10	8⁵⁄₁₆	6⅝
8½B	7⅝	5	14⅛	4¹¹⁄₁₆	16	12¼	9
9B	8⅛	12	17⅛	6⅛	18	12	10

Unit	P	S	T	W	Keyway at	
					C	E
4B	½	¹³⁄₃₂	7	3⅜	³⁄₁₆	³⁄₁₆
4½B	¾	⁹⁄₁₆	6¼	2⅜	³⁄₁₆	⁵⁄₁₆
5B	⁹⁄₁₆	¹⁷⁄₃₂	9⅛	3¹³⁄₁₆	¼	⁵⁄₁₆
5½B	⅞	¹¹⁄₁₆	13	4½	¼	⅜
6B	⅝	¹⁷⁄₃₂	12¼	3¾	¼	⅜
8B	¾	¹⁷⁄₃₂	14½	4½	⁵⁄₁₆	½
8½B	1¼	¹³⁄₁₆	18⅜	3⁷⁄₁₆	⅜	⅝
9B	1¼	¾	19	3⅜	⁷⁄₁₆	⅞

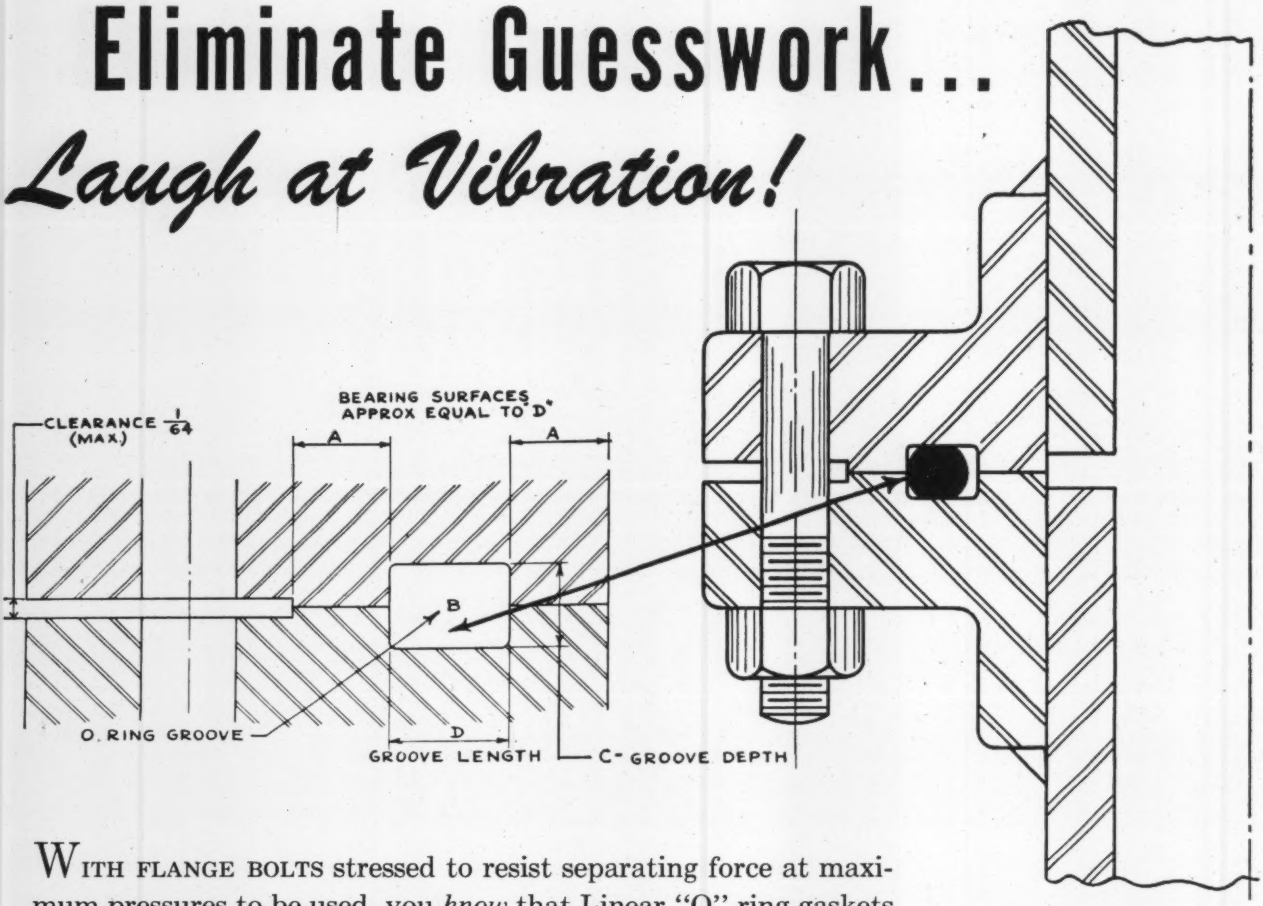
WINSMITH WHS SPEED REDUCERS

WINFIELD H. SMITH CORPORATION

333 JUNE ST. . . . SPRINGVILLE . . ERIE COUNTY . . NEW YORK

Eliminate Guesswork...

Laugh at Vibration!



"O" ring gasket for flange fittings. Groove detail shows use of the gasket.

WITH FLANGE BOLTS stressed to resist separating force at maximum pressures to be used, you *know* that Linear "O" ring gaskets will make a positive liquid or gas-tight seal. The only requirement is to maintain metal-to-metal contact between the flanges.

No more checking or periodic tightening of bolts is necessary, for once a Linear "O" ring is installed, its sealing effectiveness is unimpaired no matter how much your line vibrates!

No more costly shutdowns and repairs because of a sudden gasket blow-out. With metal-to-metal contact maintained, Linear "O" ring gaskets will seal against an unlimited pressure range. And frequent replacement is unnecessary since over-tightening cannot damage Linear "O" ring gaskets.

Available in standard sizes from 1/8″ to 15½″ ID and in special sizes as required, Linear "O" ring gaskets are moulded of natural or synthetic rubber compounds adaptable to a wide range of temperatures, gases and liquids. Linear engineering experience is at your disposal. May we serve you?

"PERFECTLY ENGINEERED PACKINGS"

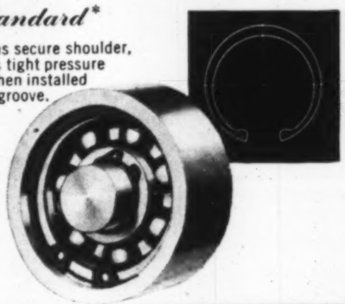
LINEAR

LINEAR, Inc., STATE ROAD & LEVICK STREET, PHILADELPHIA 35, PA.

Waldes Truarc Retaining Rings Now Nationally Distributed, Nationally Stocked

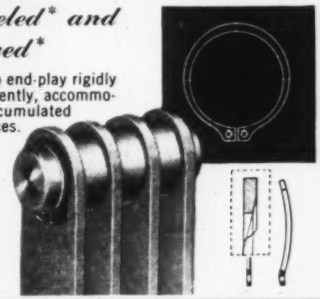
*Standard**

Forms secure shoulder, gives tight pressure fit when installed in a groove.



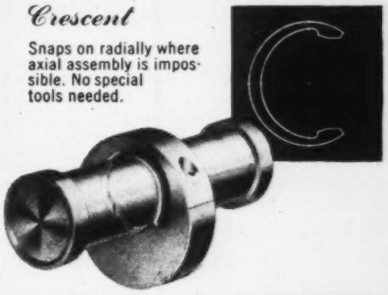
Beveled and Bowed**

Take up end-play rigidly or resiliently, accommodate accumulated tolerances.



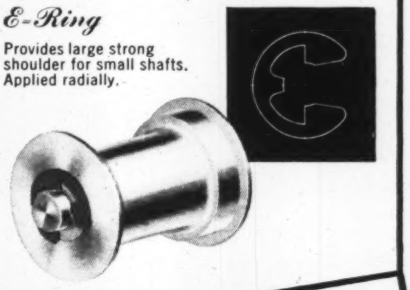
Crescent

Snaps on radially where axial assembly is impossible. No special tools needed.



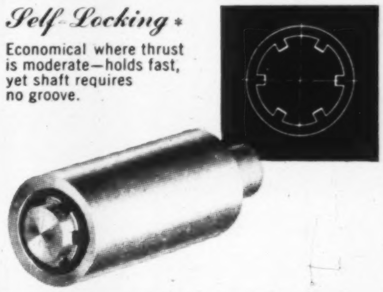
E-Ring

Provides large strong shoulder for small shafts. Applied radially.



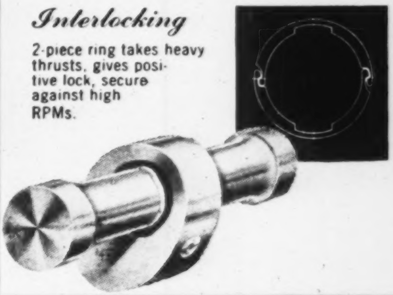
*Self-Locking**

Economical where thrust is moderate—holds fast, yet shaft requires no groove.



Interlocking

2-piece ring takes heavy thrusts, gives positive lock, secure against high RPMs.



*Available for both internal and external application

*Inverted**

For bearings with large corner radii, uniform shoulder for curved abutting surfaces.

There's a Waldes Truarc precision-engineered retaining ring to answer every need. Truarc rings give a never-failing grip because of their mathematically precise construction. No matter how demanding your specifications, it's a simple matter to refine your present designs to save material, machining and assembly costs. And now it's more convenient for you too—there's a distributor near you who stocks the rings you need. See the list below. Send your design problem to Waldes Truarc engineers, who will give it individual attention without obligation.

ONE OF THESE AUTHORIZED DISTRIBUTORS IS CONVENIENT TO YOU:

Akron, O., The Ohio Ball Bearing Co.
Albany, N. Y., Tek Bearing Co., Inc.
Appleton, Wisc., Wisconsin Bearing Co.
Atlanta, Ga., Moffatt Bearings Co.
Baltimore, Md., Moffatt Bearings Co.
Birmingham, Ala., Moffatt Bearings Co.
Bluefield, W. Va., W. Virginia Bearings, Inc.
Boston, Mass., Tek Bearing Co., Inc.
Bridgeport, Conn., Tek Bearing Co., Inc.
Buffalo, N. Y., Syracuse Bearings Co.
Canton, O., The Ohio Ball Bearing Co.
Charleston, W. Va., W. Virginia Bearings, Inc.
Charlotte, N. C., Moffatt Bearings Co.
Chicago, Ill., Berry Bearing Co.
Cincinnati, O., The Ohio Ball Bearing Co.
Cleveland, O., The Ohio Ball Bearing Co.
Columbus, O., The Ohio Ball Bearing Co.
Dayton, O., The Ohio Ball Bearing Co.
Decatur, Ill., Illinois Bearing Co.
Denver, Colo., Bearings Service Supply Co.
Detroit, Mich., Michigan Bearings Co.

Erie, Penn., Pennsylvania Bearings Inc.
Ft. Wayne, Ind., Indiana Bearings Inc.
Hamilton, O., The Ohio Ball Bearing Co.
Hammond, Ind., Berry Bearing Co.
Huntington, W. Va., West Virginia Bearings, Inc.
Indianapolis, Ind., Indiana Bearings Inc.
Ironton, O., The Ohio Ball Bearing Co.
Lafayette, Ind., Indiana Bearings Inc.
Lima, O., The Ohio Ball Bearing Co.
Lorain, O., The Ohio Ball Bearing Co.
Los Angeles, Calif., Edward D. Maltby Co.
Mansfield, O., The Ohio Ball Bearing Co.
Marion, Ill., Bearings Service Co.
Milwaukee, Wisc., Wisconsin Bearing Co.
Minneapolis, Minn., Industrial Supply Co.
Muncie, Ind., Indiana Bearings Inc.
New York, N. Y., Tek Bearing Co., Inc.
Newark, N. J., Tek Bearing Co., Inc.
Niagara Falls, N. Y., Syracuse Bearings Co.
Oakland, Calif., Bearing Specialty Co.
Peoria, Ill., Illinois Bearing Co.

Philadelphia, Penn., Moffatt Bearings Co.
Phoenix, Ariz., Edward D. Maltby Co.
Pittsburgh, Penn., Pennsylvania Bearings Inc.
Portland, Ore., O. W. I. Corporation
Providence, R. I., Tek Bearing Co., Inc.
Richmond, Va., Moffatt Bearings Co.
Rochester, N. Y., Syracuse Bearings Co.
St. Louis, Mo., Neiman Bearings Co.
Salt Lake City, Utah, Bearings Service Supply Co.
San Francisco, Calif., Bearing Specialty Co.
San Diego, Calif., Edward D. Maltby Co.
Seattle, Wash., Bearing Engineering & Supply Co.
Shreveport, La., Bearing & Transmission Co.
South Bend, Ind., Bearings Service Co.
Syracuse, N. Y., Syracuse Bearings Co.
Terre Haute, Ind., Indiana Bearings Inc.
Toledo, O., The Ohio Ball Bearing Co.
Toronto, Ont. Can., Controlite Engr. & Sales Ltd.
Wheeling, W. Va., West Virginia Bearings, Inc.
Youngstown, O., The Ohio Ball Bearing Co.
Zanesville, O., The Ohio Ball Bearing Co.

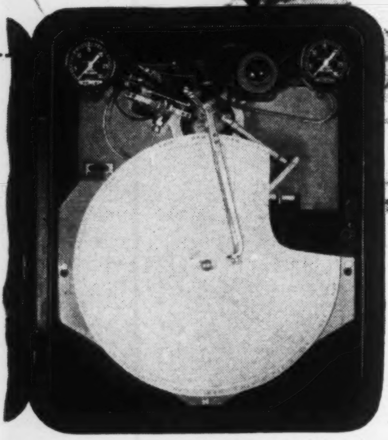
Factory engineering representatives available in each area

WALDES
TRUARC
RETAINING RINGS

WALDES KOHINOOR, INC.
LONG ISLAND CITY 1, N. Y.

WALDES TRUARC RETAINING RINGS ARE PROTECTED BY U. S. PATS. 2,302,948; 2,026,454; 2,416,852 AND BY OTHER PATS. PENDING.

"I buy Masoneilan Instruments because of their simplicity accessibility of all parts, ruggedness and dependable performance"



No. 2110
PRESSURE CONTROLLER

Proportional type, designed for precise control of pressure. Stable and smooth in operation. Proportional band adjustment throughout entire range without upsetting control. Ranges 30 inches Hg. vacuum to 3,000 psi.

MASONEILAN
TEMPERATURE

No. 3110
TEMPERATURE CONTROLLER

Proportional type for exact control of temperatures in petro-chemical processes. Its smooth operation assures accuracy and uniformity under varying conditions. Ranges −100°F to 1100°F in recording and non-recording types.

Throughout the petrochemical industry, engineers state their preference for Masoneilan Instruments because of the simplicity of operation and accessibility of all parts.

The simplicity of operating elements assures instant, uniform response under practically all types of operating conditions. The accessibility of all parts enables you to observe the working operation of every element.

Masoneilan Instruments, pressure and temperature, are available in indicating and recording types for a wide variety of control applications in the petrochemical industries. Investigate these Masoneilan control instruments for your processes.

MASONEILAN

MASON-NEILAN REGULATOR COMPANY

1208 Adams Street, Boston 24, Mass., U.S.A.

Philadelphia • Houston • Pittsburgh • New York • Buffalo • Chicago • St. Louis • Cleveland • Tulsa • Atlanta
Los Angeles • San Francisco • Cincinnati • Mason Regulator Company of Canada, Ltd., Montreal and Toronto

Why American *Flexible* Seamless *is so widely serviceable*

IN COUNTLESS APPLICATIONS, handling oil, steam, water, and other liquids, gases and semi-solids, American Seamless successfully withstands heat, vibration, pressure, abrasion, corrosion and repeated flexing. The way it is made (see below), accounts for the superior performance and widespread utility of this quality product. Write for Publication SS-50, which gives detailed information on types and uses of American Flexible Metal Hose and Tubing.

1 Heavy-walled tubes are reduced in our own plant to the proper thickness for forming into flexible tubing. Exact dimensions assure maximum service life.

2 After annealing, the thin-walled tubes are corrugated to provide flexibility. Special machines form these corrugations in either an annular or helical pattern.

3 After corrugating, one or more wire braids are applied, depending on the service. Braids provide added strength and prevent elongation under pressure.

4 Although American Seamless is sold with or without fittings attached, it is usually supplied in the form of complete assemblies ready for installation. Either soldered-on or heatproof couplings are available.

46353

ANACONDA

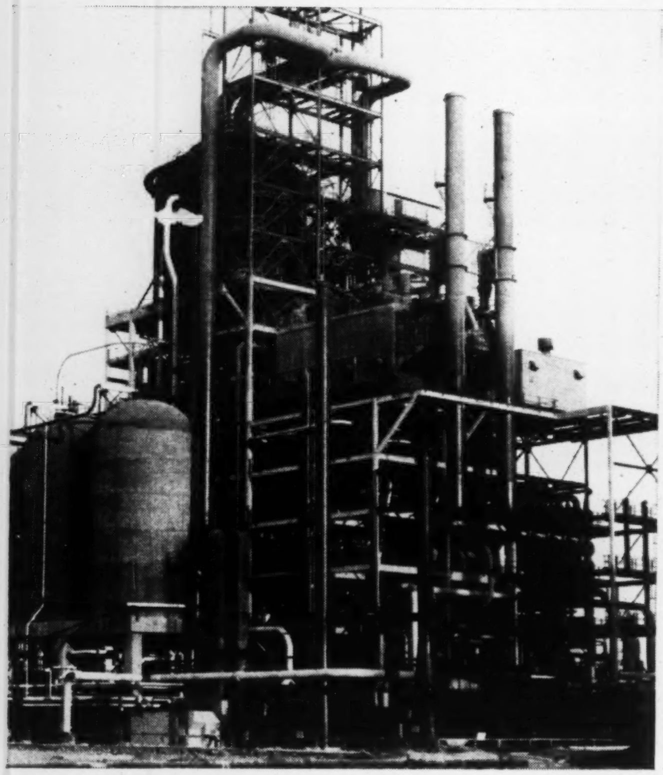
American

METAL HOSE

THE AMERICAN BRASS COMPANY
American Metal Hose Branch
General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada: **ANACONDA AMERICAN BRASS LTD.,**
New Toronto, Ont.

NATIONAL AIROIL
FUEL OIL - GAS
BURNERS

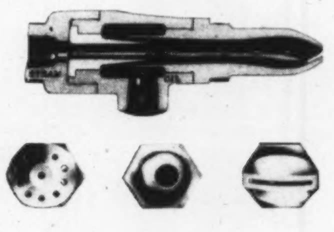
THE *RIGHT* BURNER
OR COMBINATION OF BURNERS FOR
YOUR NEEDS



Whether you burn oil, gas or a combination of fuels, there's a *NATIONAL AIROIL BURNER* for *your job*.

Our more than 35 years' experience in the design, development and manufacture of all types of industrial burners is *at your service*.

Ask us about your requirements . . . we'll gladly give you full information.



TYPE "SA"

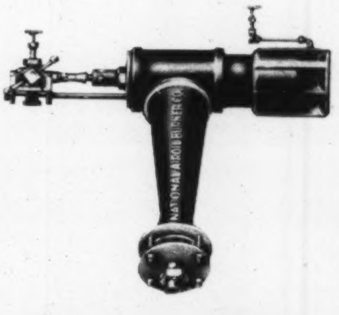
(For use where steam is available) *atomizes thoroughly* and *burns completely*, the lowest and cheapest grades of fuel oil and tar, requiring low oil pressure and temperatures.

TYPE "SAL"

(Large capacity burner similar to TYPE SAR is adaptable in combination with powdered coal burners in large boilers.

TYPE "SAR"

(Where steam, or gas is available for atomizing) safely and efficiently burns residuums obtained from process.

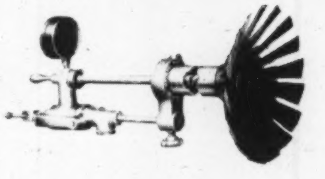


COMBINATION GAS AND OIL BURNER

—and "AIROCOOL" Gas Burner in combination with a TYPE SAR Oil Burner.

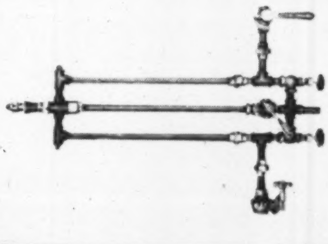
"AIROCOOL" GAS BURNER

(Of venturi type) assures low turndown without burnback.



MECHANICAL—PRESSURE ATOMIZING OIL BURNER

with multi-vane type air diffuser to give a positive swirl to entering combustion air.



TYPE "S-A-D"

(Refuse Oil Burner) burns acids or caustic oils, sludges, asphalts, tank bottoms, polymer oils, heavy petrolatum, organic oil residuums, waste cutting oils, sulphite pulp liquors, etc.

NATIONAL AIROIL BURNER CO., INC.

Main Offices & Factory: **1239 EAST SEDGLEY AVENUE, PHILADELPHIA 34, PA.**
Texas Office: 2nd National Bank Bldg., Houston

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

THIS FREE BOOKLET MAY SAVE YOU THOUSANDS OF DOLLARS

HERE'S THE ANSWER TO "TOUGH" PUMPING PROBLEMS!

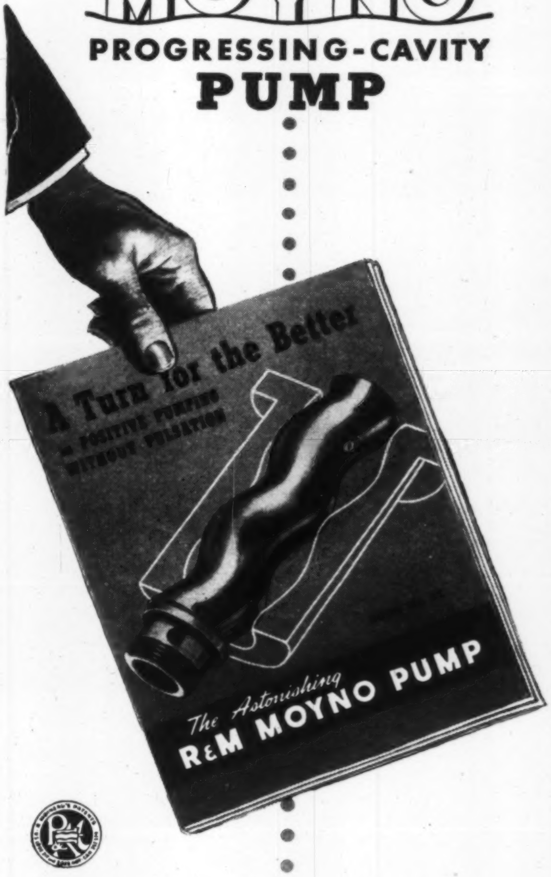
R & M

MOYNO®

PROGRESSING-CAVITY

PUMP

- Pumps abrasives, chemicals
- Passes particles—meters flow
- Gives continuous, uniform output
- Self-primes—reverses
- Has only one moving part


A Turn for the Better
in POSITIVE PUMPING WITHOUT PULSATION
The Astonishing R&M MOYNO PUMP

Moyno pumps have solved hundreds of industry's most difficult pumping problems. They handle virtually *anything* that will push through a pipe—volatile liquids, solids in suspension, abrasive sludge—yes, even non-pourable pastes. "Progressing-cavity" action does the trick. And Moyno *stamina* assures dependability. Here's the pump that *stands up where others fail.*

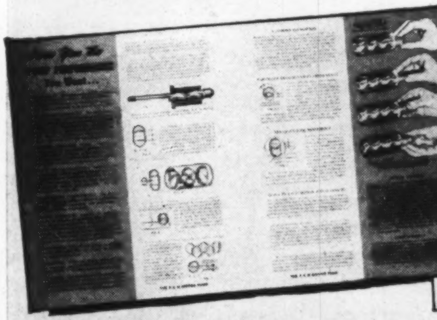
SIMPLE AS A-B-C

No pistons, no valves, no high-speed impellers. A single helical rotor forms continuous, *ever-changing* seal lines—spreads wear evenly over *all* surfaces. The Moyno is non-clogging and non-vapor-locking. Delivers positive, *non-pulsating* discharge at pressures to 1000 p.s.i.

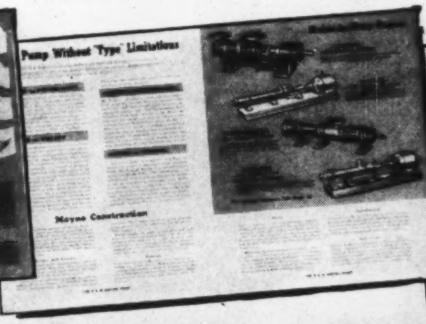
THE PUMP WITH A THOUSAND USES

Probably the Moyno is the answer to *your* pumping problems, too. Write today for your free copy of Book No. M22E. It lists many typical applications, shows installations, gives sizes, pressures, and capacities.

"PROGRESSING-CAVITY" ACTION



CONSTRUCTION AND PERFORMANCE


Pump Without 'Type' Limitations
Moyno Construction

STANDARD AND SPECIAL-PURPOSE MOYNOS

The R&M Moyno Standard Pump

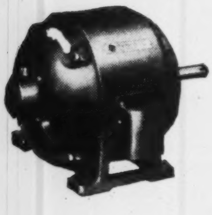
ROBBINS & MYERS · INC. MOYNO PUMP DIVISION
Springfield 99, Ohio • Brantford, Ontario

MOTORS • HOISTS • CRANES • FANS • MOYNO PUMPS • FOUNDED 1878

Designer's

LOOK HOW THE FAMILY'S GROWN!

YOU CAN NOW GET TRI/CLAD EXTRA PROTECTION IN ALL THESE IMPORTANT MOTOR TYPES!

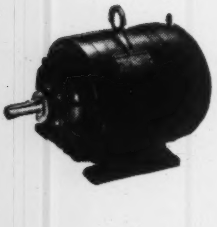


Tri-Clad Open (Dripproof)

A general-purpose induction motor for use where constant speed, "snappy" starting ability and high momentary load-carrying capacity are required. Ratings from ¼ to 2000 hp; 25, 50 and 60 cycles. Check Bulletin GEA-3992 for more data.

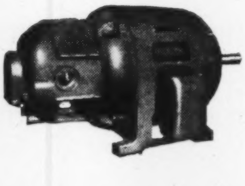
Tri-Clad Vertical

Use wherever a vertical drive is required for efficiency or improved appearance. This motor may be installed outdoors in mild climates. Ratings from ½ to 500 hp; 25, 50 and 60 cycles. Check Bulletin GEA-4645 for complete details.



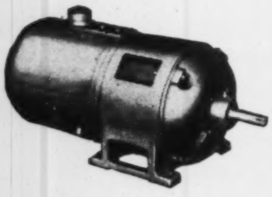
Tri-Clad Totally Enclosed

Industry's most dependable induction motor. Designed in several constructions for use in many adverse atmospheres—in iron dust, outdoors, in hazardous areas, and chemical atmospheres. Ratings from 1 to 1000 hp; 25, 50 and 60 cycles. Check Bulletin GEA-4400.



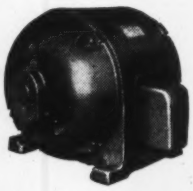
Tri-Clad Wound-Rotor

Suitable for constant-speed applications requiring frequent starting or reversing under heavy load, or where exceptionally high starting torque is encountered. Can also be used where adjustable-varying speeds are required. Ratings from 20 to 1750 hp; 25, 50 and 60 cycles.



Tri-Clad Type ACA

The newest member of the Tri-Clad family! At the twist of a dial this adjustable speed induction motor changes speed over a 3 to 1 range. Quiet, smooth-running, and compact. Ratings from 3 to 50 hp; 3-phase; 60 cycles. Check Bulletin GEA-4883.



Tri-Clad Converter

To supply frequencies from 360 to 2160 cycles for high-speed induction motors which drive grinders, drills, routers. This inductor frequency converter is a single-unit machine, operating from a standard 60-cycle supply. Check Bulletin GEA-4903.

GENERAL ELECTRIC

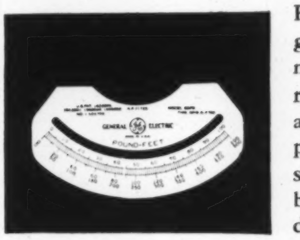
Digest

TIMELY HIGHLIGHTS ON GE PRODUCTS

TIME IT . . . *for more output!*

G-E time meters provide an accurate record of the total operating time of an electrically operated machine or device. You know exactly which machines are being kept profitably busy . . . there's no guesswork! General Electric makes time meters in three forms: panel or switchboard mounted (square or round), conduit mounted, and portable. Time can be recorded in hours, tenths of hours, or minutes. Available for 110-, 115-, 230-, and 460-volt operation; 25, 50, and 60 cycles. Check Bulletin GEA-3299.

TELLS TORQUE . . . *in pound-feet!*



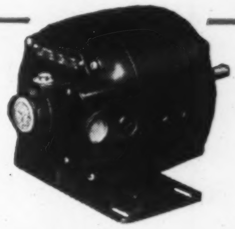
Here's a torque meter that gives you quick, accurate measurements of torque directly in pound-feet without absorbing power from the prime mover or load. You simply couple the shaft unit between the load and the driving unit. No cradling is necessary. Absolute accuracy within ± 1% of full-scale reading is provided—repetitive accuracy within ± 0.5%. Meter consists of shaft unit, power unit, oscillator and indicating instruments. Check Bulletin GEA-4441.

OILTIGHT . . . *and neat, too!*

G-E oiltight push buttons prevent fouling of push-button contact by cutting- or lubricating-oil seepage. With this common cause of work stoppage eliminated, your machines gain in user satisfaction. They're small, easy to mount; fit in the same size hole as indicator lights and selector switches. They "dress up" your product, too. Standard, back-connected units with single-pole, double-throw contacts or double-pole, single-throw contacts are available. Check Bulletin GEA-4254.

IF IT'S A D-C "FRACTIONAL"

we have it . . . now!



We've caught up! After producing more d-c fractional-horsepower motors in the past few years than ever before, we can now supply you with the following d-c fhp motors on a short delivery schedule. Whether it's ten units you need, or a hundred, or even a thousand, we're ready to serve you—quickly!

HERE ARE THE TYPES AVAILABLE!

General-purpose d-c motors (115 and 230 volts); d-c generators and motor generator sets (output ratings of 125-, 250-, and 500-watt continuous duty (125 and 250 d-c volts); low-voltage d-c motors; dynamotors (200- and 500-volt-amperes, 60 cycles); a-c generators (200- and 500-volt-amperes, 115 volts, 60 cycles); motor amplidyne-generators and amplidyne generators; high-frequency alternators (2.5 kva, 3 phase, or 1.5 kva, single phase, both at 400 cycle, 115 volts).

HERE'S WHAT TO DO!

Call the nearest G-E office for complete information, or check Bulletin GEA-4871 on the coupon for a brief description of these motors.

GENERAL ELECTRIC COMPANY
Apparatus Dept., Section G668-58, Schenectady 5, N. Y.

Please send me the following bulletins:

- ☐ GEA-3992—Open Tri-Clads
- ☐ GEA-4400—Totally Enclosed Tri-Clads
- ☐ GEA-4883—Type ACA Tri-Clads
- ☐ GEA-4645—Vertical Tri-Clads
- ☐ GEA-4903—Tri-Clad Converters
- ☐ GEA-4871—D-C Fractional Motors
- ☐ GEA-3299—Time Meters
- ☐ GEA-4441—Torque Meter
- ☐ GEA-4254—Oiltight Push Buttons

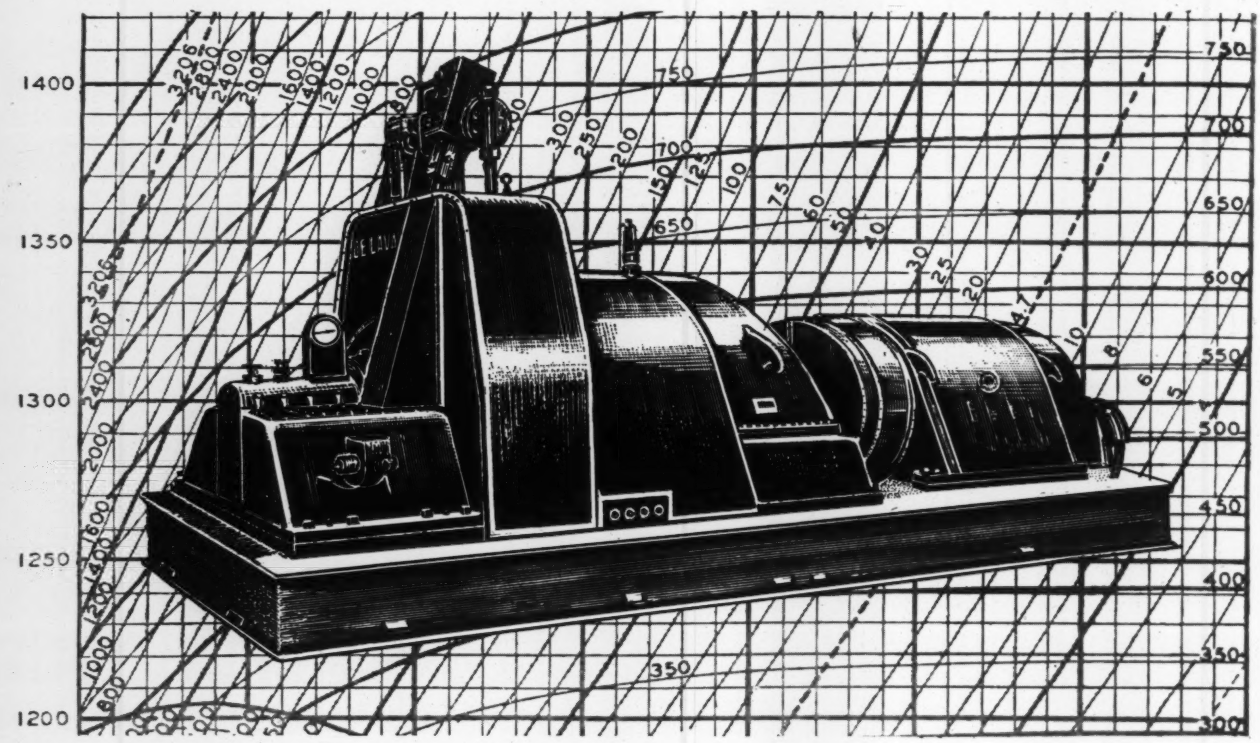
CONSULT YOUR SWEET'S! You'll find "everything electric" for machinery manufacturers in the General Electric section.

NAME ....

COMPANY ....

STREET ....

CITY .... STATE ....


1400
1350
1300
1250
1200
750
700
650
600
550
500
450
400
350
300
3206
2800
2400
2000
1600
1400
1200
1000
800
300
250
200
150
125
100
75
60
50
40
30
25
20
14.7
10
8
6
5
DE LAVAL

SKIM THE POWER CREAM

from process steam

If you use appreciable quantities of steam consider the economy of generating all or a part of your own power by allowing the steam to expand through a De Laval Turbine before delivery to the heating or processing system.

De Laval Turbines can be furnished with automatic controls designed to make exhaust steam available in the quantities and at the pressures required to meet the demands of plant operation and the requirements of thermo-dynamic economy.

May we have the privilege of submitting cost figures based upon the installation of a De Laval turbine selected to meet your plant requirements?

T-7

DE LAVAL

DE LAVAL STEAM TURBINE CO., TRENTON 2, N. J.

Atlanta • Boston • Charlotte • Chicago • Cleveland • Denver • Detroit • Helena • Houston • Kansas City
Los Angeles • New Orleans • New York • Philadelphia • Pittsburgh • Rochester • Salt Lake City
San Francisco • Seattle • St. Paul • Tulsa • Washington, D. C. • Edmonton • Toronto • Vancouver • Winnipeg

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

an SK "reason why"

as simple as

With an SK Jet Compressor . . .
Circulation of steam for better heating . . .
Boosting of low pressure steam . . .
And mixing of gases in desired proportion . . .
Become as simple as ABC.

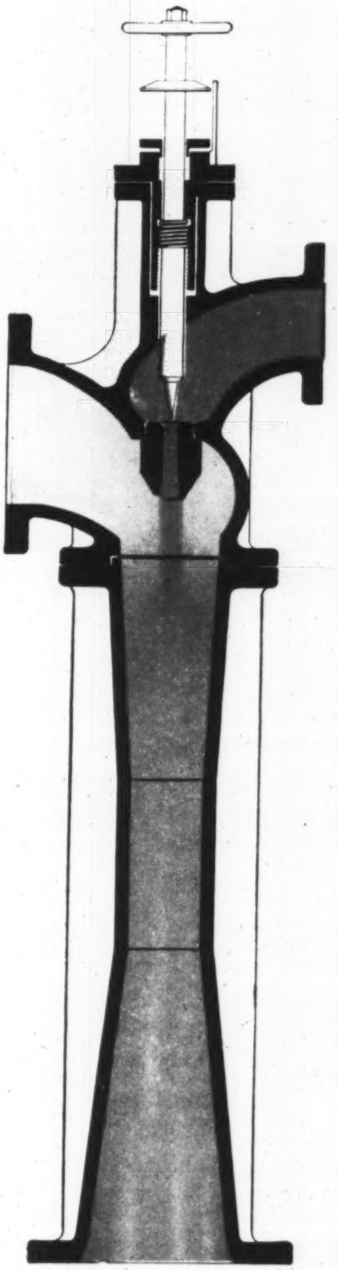
The SK Jet Compressor . . .
Utilizes a jet of high pressure gas . . .
To entrain a low pressure gas . . .
Mix the two . . .
And discharge them . . .
At an intermediate pressure.

The SK Jet Compressor is of simple construction . . .
With no rapidly revolving parts . . .
To get out of order . . .
Adjust or repair.
It reduces wear to a minimum . . .
Requires little maintenance . . .
Operates economically . . .
With maximum efficiency.

Write for SK Bulletin 4-F . . .
It contains detailed information.

SCHUTTE and KOERTING Company
Manufacturing Engineers
1166 THOMPSON ST., PHILADELPHIA 22, PA.

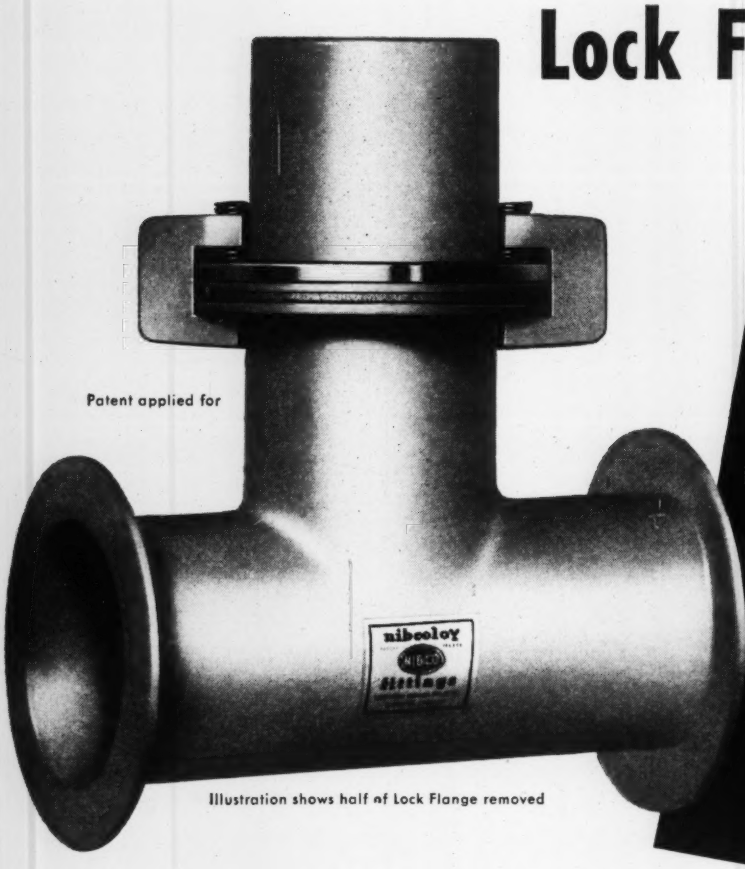
JET APPARATUS • CONDENSERS AND VACUUM PUMPS • HEAT TRANSFER EQUIPMENT
VALVES • ROTAMETERS AND FLOW INDICATORS • GEAR PUMPS • STRAINERS
OIL BURNING EQUIPMENT • SPRAY NOZZLES AND ATOMIZERS • RADIAFIN TUBES



NEW... EXCLUSIVE!

Nibcoloy

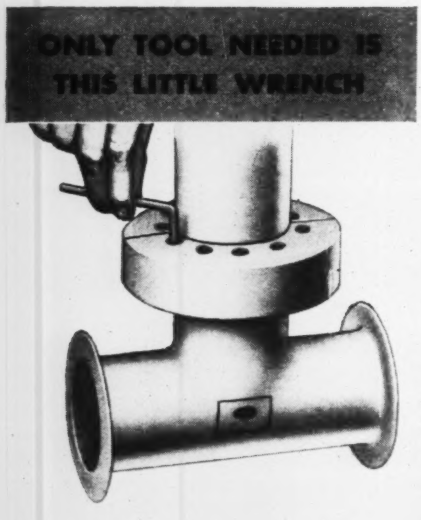
Lock Flange Fittings



Patent applied for

Illustration shows half of Lock Flange removed

Simplest,
most economical
method of installing
demountable
alloy piping



ONLY TOOL NEEDED IS THIS LITTLE WRENCH

Just a few twists with a set screw wrench and you break a NIBCOLOY Lock Flange joint—for inspection, cleaning, renewing gaskets, or for a change in the line itself. The simple, direct connection is just as easily restored... Fittings are available in Inconel, Nickel and Monel and stainless steel (Types 316-347-304). Lock Flange is manganese bronze, Drive Ring of stainless steel and set screws are rust-proofed carbon steel... NIBCOLOY lock flange fittings can be produced to meet your specific needs. Your detailed inquiry is solicited. Mail coupon for Catalog 902 covering the entire line of NIBCOLOY wrot fittings.

Northern Indiana Brass Co., 209 Plum St., Elkhart, Indiana.
Please send your catalog 902, including complete information about the exclusive New Nibcoloy Lock Flange.

Individual______________________________

Company______________________________

Address______________________________

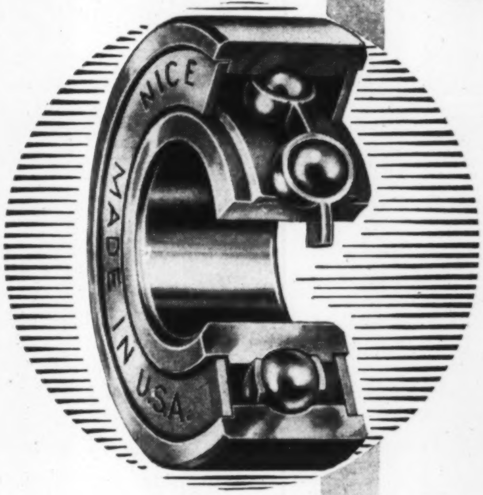
The Chances Are...

IT WILL BE TO YOUR ADVANTAGE TO INVESTIGATE

NICE

BALL BEARINGS

NICE offers, for your consideration, several complete lines of "catalog standards", a few types of which are illustrated. In addition, Nice is tooled to produce many hundreds of "specials", and experienced Nice engineers are prepared to recommend or design the "exactly right" bearing for your application.



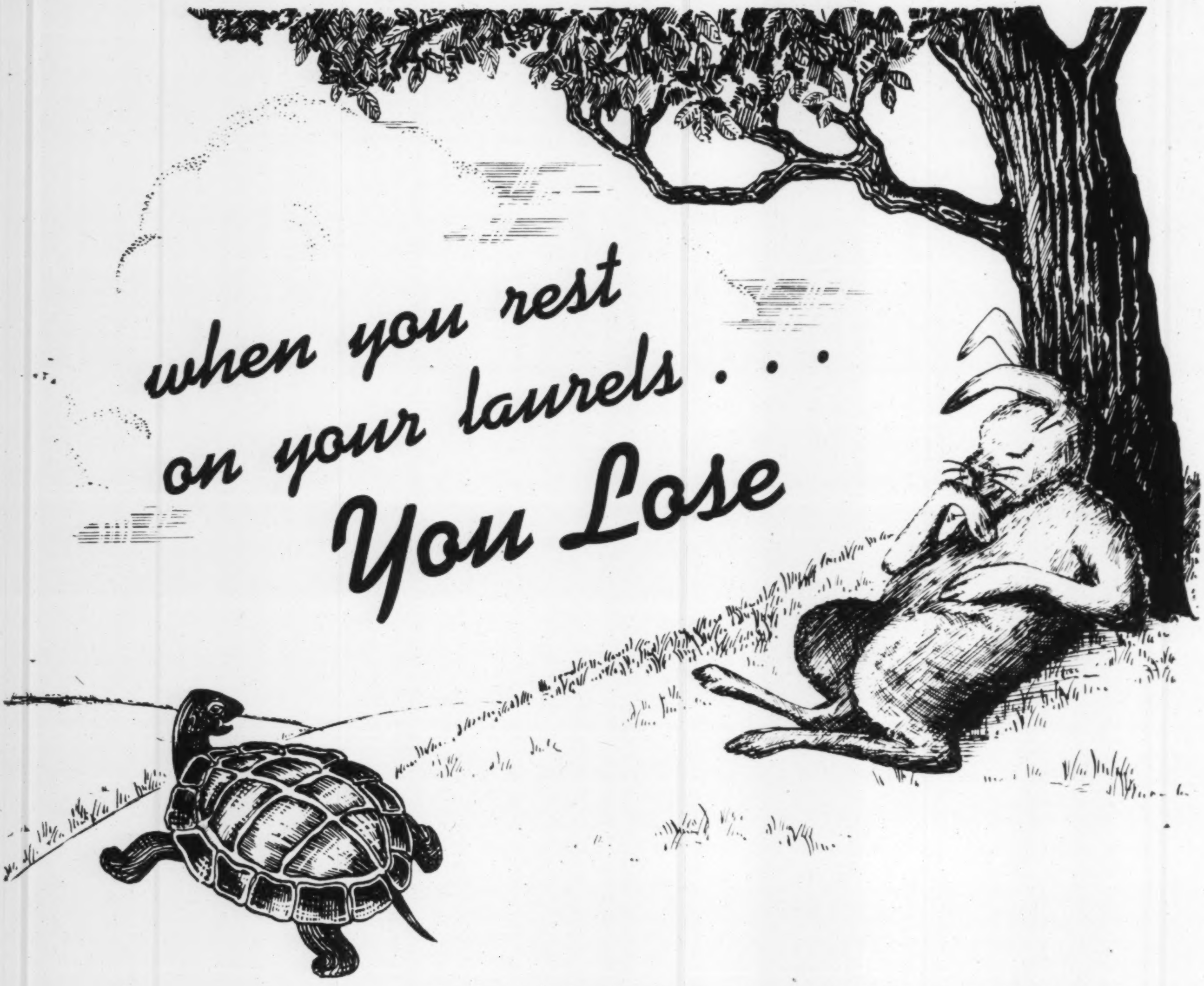
NICE BALL BEARING COMPANY Sales Offices are located in Philadelphia, Chicago, Detroit, Dallas, Texas and Charlotte, North Carolina.

Standard catalog bearings are stocked at the factory, and are also stocked by the BOSTON GEAR WORKS, DIVISION THE MURRAY COMPANY, with six branches and ninety distributors located in all principal cities of the United States.

Write for Catalogue No. 125

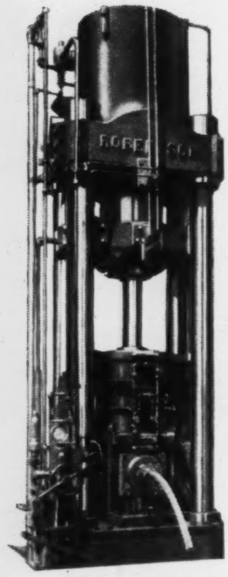
NICE

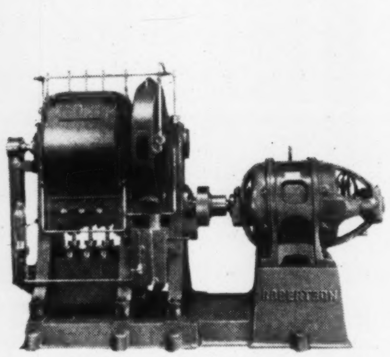
NICE BALL BEARING COMPANY
NICETOWN · PHILADELPHIA · PENNSYLVANIA



The story of the speed demon hare and the slow but steady tortoise illustrates, very clearly, the danger of resting on your laurels. The hare had speed to burn; he was good and he knew it. But while he took his "forty winks", look who won the race.

In 89 years, Robertson has *never* rested on its laurels, has *never* been satisfied to produce high pressure hydraulic equipment that was just "good enough." Rather, Robertson has consistently improved and refined its machines. This untiring devotion to the principle of improvement has caused leading wire and cable manufacturers the world over to specify, order and use Robertson Equipment so extensively—in many cases, *exclusively*—throughout the years.

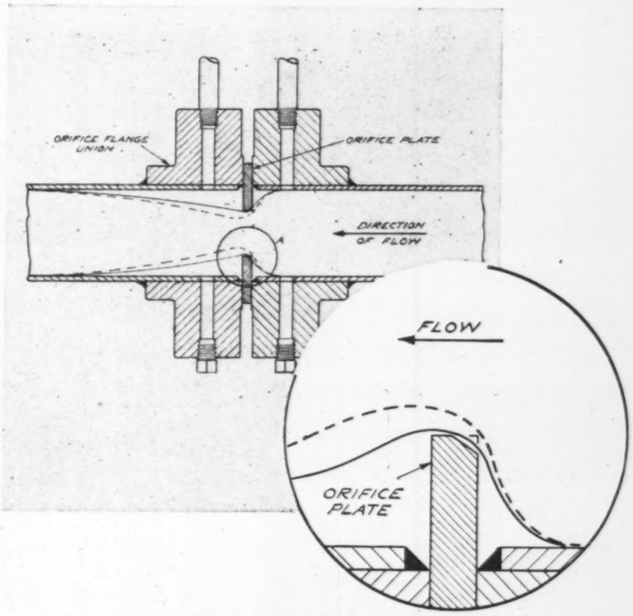

Cable Lead
Encasing Press


No. 50
Hydraulic Pump

JOHN Robertson
COMPANY INCORPORATED
121-137 WATER STREET, BROOKLYN 1, NEW YORK
Designers and Builders of all Types of Lead Encasing Machinery
Since 1858

BACK UP FLOW METER ACCURACY

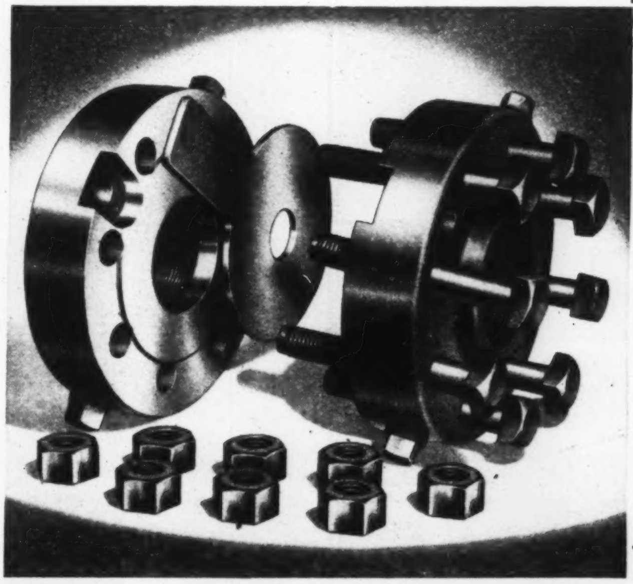
with Accurately-made Orifice Plates



THE PRECISION TOLERANCES of Foxboro Orifice Plates may seem extreme, but results over the years have paid off in worthwhile savings to users. These thin-plate, square-edge orifices are bored to an accuracy of 1/20th of 1% of the orifice diameter . . . which means a measuring accuracy within 1/10 of 1% (0.001).

The importance of the *square* leading edge can be seen from the diagram at the right. If the upstream edge of the orifice is dulled to a radius of as little as .005", it's equivalent to an orifice bored .01" too large . . . resulting in an error in flow measurement of as much as 2% or more, depending on orifice size.

Naturally, orifice plates made to close limits of accuracy require careful storage and handling. They are and should be regarded as a very important part of the flow meter installation.



Check these Advantages of FOXBORO Orifice Plates

Reg. U. S. Pat. Off.

- ★ **Precision bored, with square upstream edge, for maximum accuracy**
- ★ **Supplied in metal best suited to specific service conditions**
- ★ **Bored plates enclosed in individual envelopes for protection during shipment and storage**
- ★ **Easy to install between union flanges**
- ★ **Data always visible on projecting tabs**
- ★ **Low in cost**

Write, giving available details of your metering problem, for further details on Foxboro Orifice Plates. (Foxboro also furnishes flow nozzles, Venturi tubes, and Pitot tubes, whenever requirements call for these alternative primary elements.) We'll gladly send bulletin which describes Foxboro Flow Meters as well. Address: The Foxboro Company, 182 Neponset Ave., Foxboro, Mass., U. S. A.

FOXBORO ORIFICE PLATES

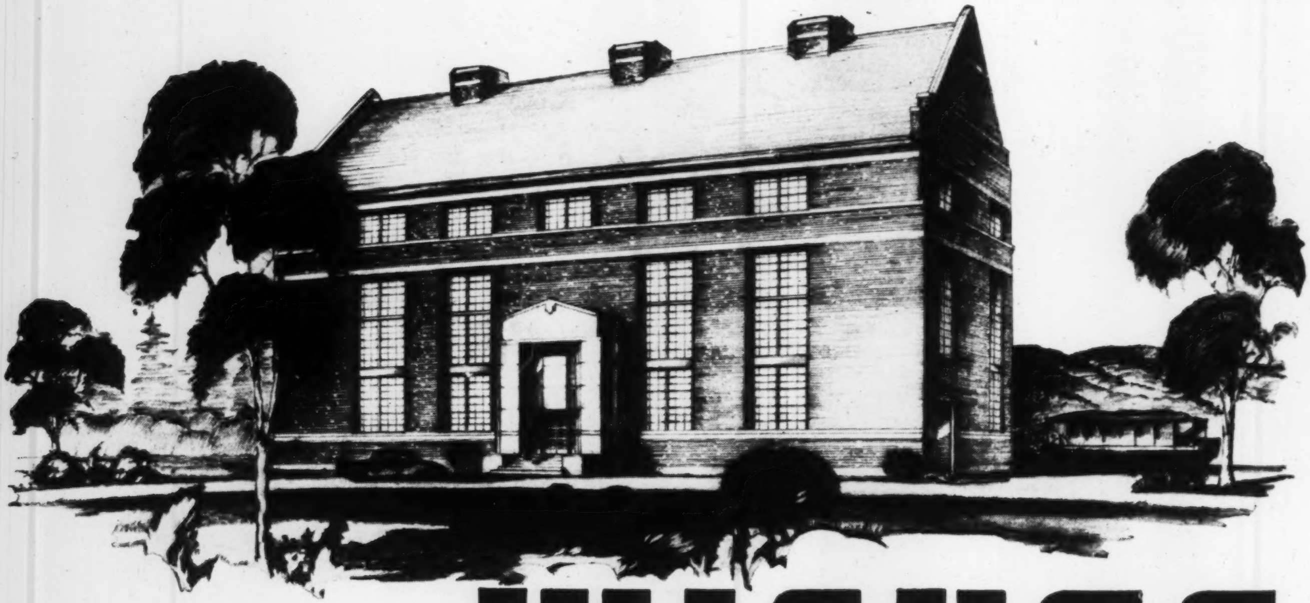
REG. U. S. PAT. OFF.

MODERN DESIGN AND EFFICIENCY GO HAND IN HAND WITH WICKES QUALITY AT *Michigan State College*

EAST LANSING, MICHIGAN

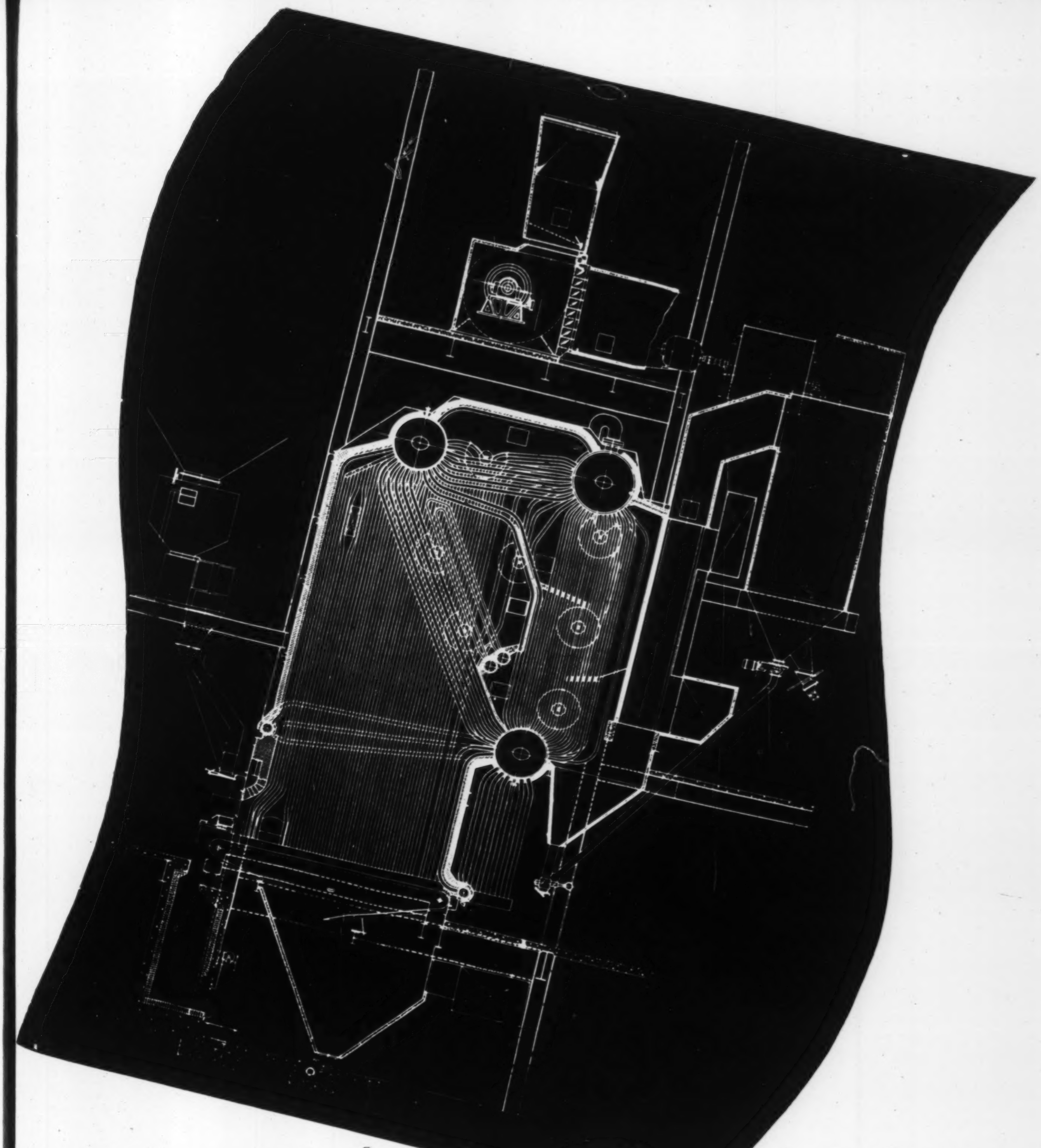
This modern steam generation plant pictured below houses the *eleventh* Wickes Boiler installed at Michigan State College with space provided for the 12th unit. Working to the specifications of Claud R. Erickson, consulting engineer of Lansing, Michigan, Wickes designed a 3-drum boiler that makes this installation the *most modern, efficient generation plant* to be found at any educational institution in the country. Boiler specifications: capacity, 125,000 lb. per hr.; design pressure, 350 psi; total steam temperature, 550°F

Wickes has the engineers, the manufacturing facilities, and the skilled workmen to fill your requirements for *boilers of any type up to 250,000 lb. steam per hour and 850 psi.* Your inquiries will receive prompt attention.



WICKES

RECOGNIZED QUALITY SINCE 1854



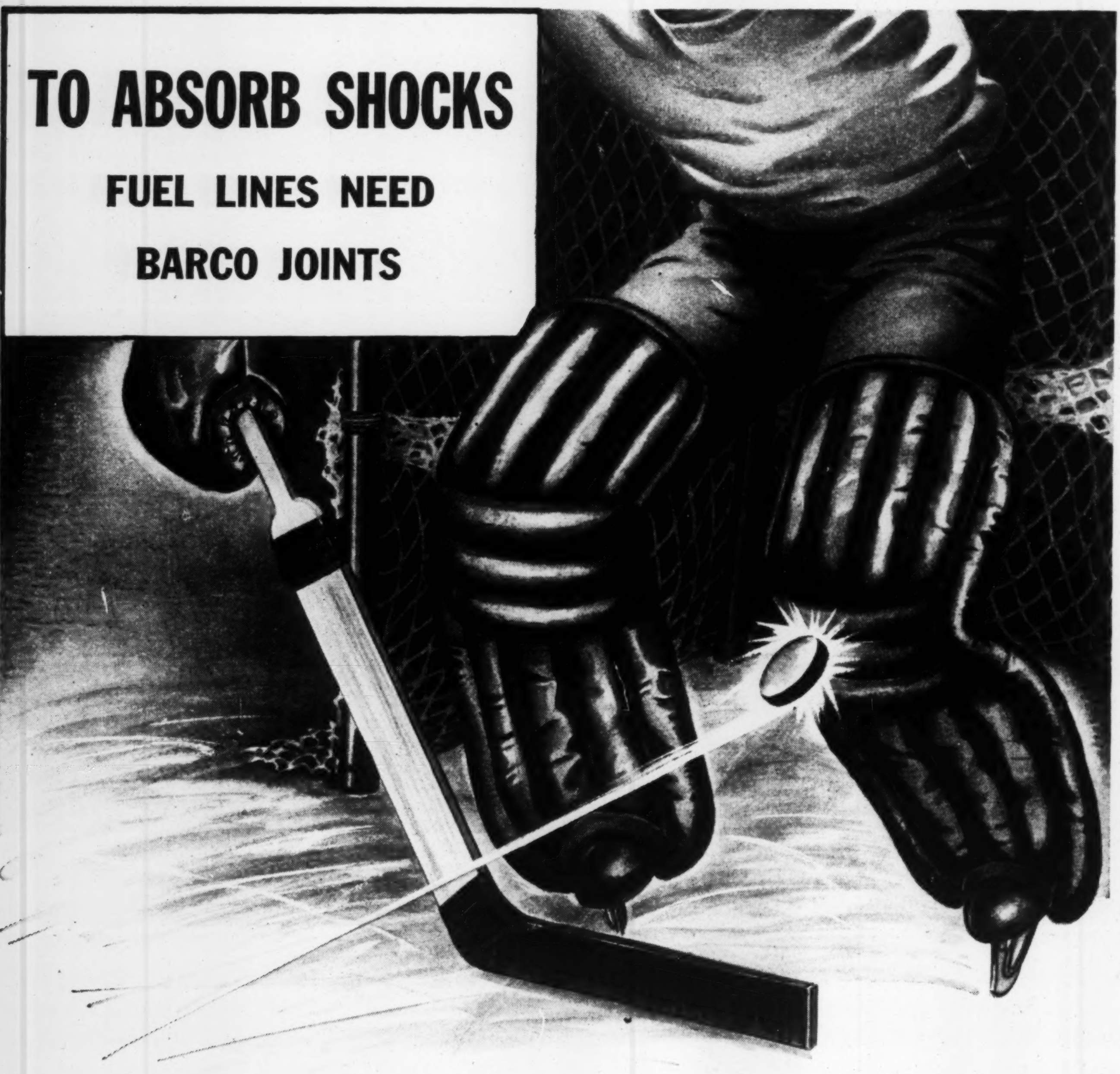
BOILER

SAGINAW, MICHIGAN

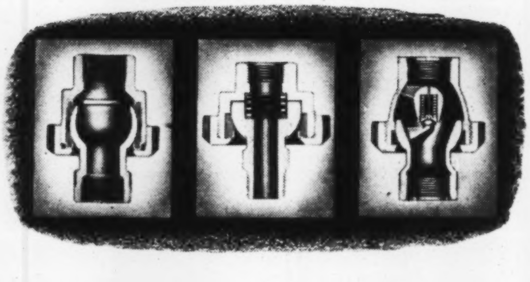
SALES OFFICES: Atlanta • Boston • Charlotte, N. C. • Chicago • Cincinnati • Denver • Detroit
Houston, Texas • Indianapolis • Kansas City • Los Angeles • Milwaukee • New York City
Peoria, Illinois • Pittsburgh • Saginaw • San Francisco • San Jose, Calif • Seattle • St. Louis
Tulsa, Okla. • Mexico City

TO ABSORB SHOCKS

FUEL LINES NEED BARCO JOINTS



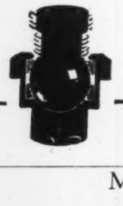
Fuel lines don't last long unless, like this hockey goalkeeper, they are protected from impact and shocks. Barco Flexible Joints, by responsive movement through every angle, absorb shocks and stresses in fuel lines, compensate for expansion and contraction. For over 30 years, these valuable time and cost savers have been guarding fluid-conveying systems from the deadly effects of vibration, preventing leakage and fractures. Whatever your special installation may be, you'll find the right joint for it in the Barco line. Write for complete facts. Barco Manufacturing Company, Not Inc., 1807 Winnemac Avenue, Chicago 40, Illinois. In Canada: The Holden Co., Ltd., Montreal, Can.



BARCO FLEXIBLE JOINTS

FREE ENTERPRISE—THE CORNERSTONE OF AMERICAN PROSPERITY

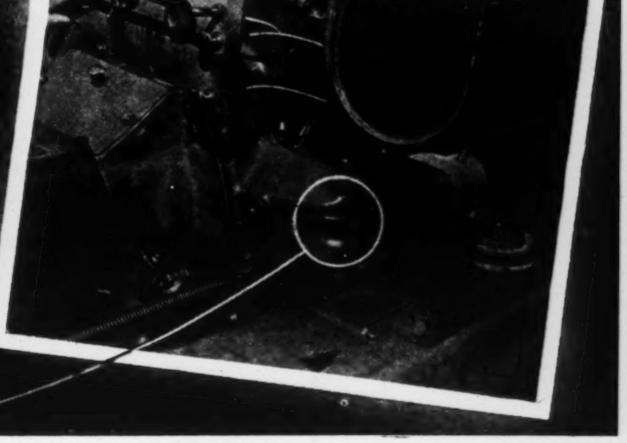
Not just a swivel joint ...but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.



"MOVE IN EVERY DIRECTION"

TOWMOTORS *Cut* OPERATING COSTS

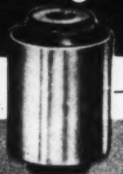
ANOTHER EXAMPLE OF PRODUCT IMPROVEMENT
by
LORD
VIBRATION CONTROL SYSTEMS



LORD ENGINE MOUNTINGS

Cut Maintenance

Protect Engine From Destructive Shock, Frame Twist . . . Help Keep Trucks Operating Longer, Better, Cheaper



Shear Type Bonded Rubber design gives superior shock isolation—Long Service Life.

The Lord line of mountings covers a complete range of styles, shapes, and sizes to fill your mounting requirements.

VERTICAL SNUBBING
SHEAR TYPE MOUNTINGS

Send for your copy of Bulletin 103; it contains valuable information on Vibration Control.

IN the Towmotor an effective means of cushioning shock and of accomodating misalignment between the vehicle frame and the engine was essential. This protection for the power plant was obtained by the use of Lord Bonded Rubber Tube Form Mountings.

In addition to these advantages the flexible mounting of the motor on four Lord Tube Form Mountings achieves a smooth delivery of power that improves performance, reduces transmission of engine noise, and decreases operator fatigue . . . all of which means greater customer satisfaction and increased sales.

A Lord Vibration Control System adds little to cost—adds immeasurably to performance and length of service. Bring your vibration problems to Lord—Vibration Control Headquarters.

LORD

MAKE GOOD PRODUCTS BETTER

with *Vibration Control*

LORD MANUFACTURING CO. · ERIE, PA.

Field Offices: Detroit • Chicago • New York • Washington, D.C.
Providence, R. I. • Burbank, Cal. • Philadelphia, Pa.
Canadian Representative: Railway & Power Engineering Corp., Ltd.

PERMANENT RESILIENCE

Resilient parts made from HYCAR synthetic rubber *stay* resilient. That's partly because of HYCAR's unusual chemical stability—its resistance to oil and gas, acids and most other chemicals. And parts made from HYCAR are extremely resistant to the effects of oxidation, sunlight, and normal aging. A HYCAR sealing ring, for example, will maintain a positive seal through years of service even when constantly exposed to oils and acids inside the pipe, and sunlight and salt air outside.

Other unusual and valuable properties are listed in the box at the right. But most important, these properties may be had in an almost limitless number of combinations, each designed to meet the specific service conditions of the finished part. Parts made from HYCAR have seen service in *every* industry, giving long life, dependability, and economical operation.

That's why we say ask your supplier for parts made from HYCAR. Test them in your own applications, difficult or routine. You'll learn for yourself that it's wise to use HYCAR for long-time, dependable performance. For more information, please write Dept. HF-2, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

CHECK THESE SUPERIOR FEATURES OF HYCAR

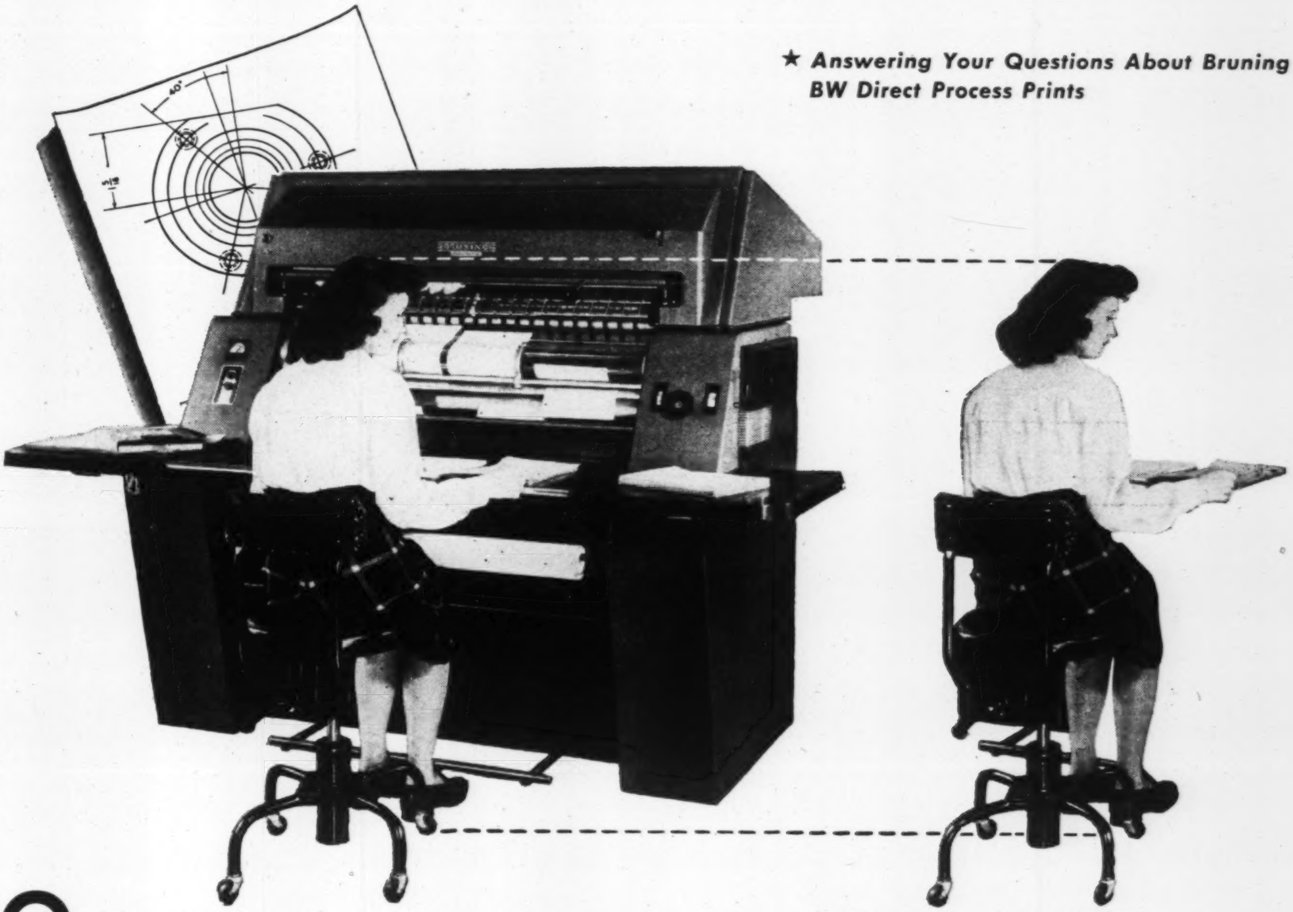
1. *EXTREME OIL RESISTANCE — insuring dimensional stability of parts.*
2. *HIGH TEMPERATURE RESISTANCE—up to 250° F. dry heat; up to 300° F. hot oil.*
3. *ABRASION RESISTANCE—50% greater than natural rubber.*
4. *MINIMUM COLD FLOW—even at elevated temperatures.*
5. *LOW TEMPERATURE FLEXIBILITY — down to —65° F.*
6. *LIGHT WEIGHT—15% to 25% lighter than many other synthetic rubbers.*
7. *AGE RESISTANCE—exceptionally resistant to checking or cracking from oxidation.*
8. *HARDNESS RANGE—compounds can be varied from extremely soft to bone hard.*
9. *NON-ADHERENT TO METAL—compounds will not adhere to metals even after prolonged contact under pressure. (Metal adhesions can be readily obtained when desired.)*

Hycar
Reg U S Pat Off
American Rubber

B. F. Goodrich Chemical Company A DIVISION OF THE B. F. GOODRICH COMPANY

GEON polyvinyl materials • HYCAR American rubber • KRISTON thermosetting resins • GOOD-RITE chemicals

★ ***Answering Your Questions About Bruning BW Direct Process Prints***



Q. How many operators will I need?

A. Even the largest Bruning Printer-Developers—designed for big-volume production—require only one operator to produce Bruning BW positive prints made directly from any transparent or translucent originals—in seconds. Unlike blue prints, which are negatives, BW Prints are direct line positive prints—black or colored lines on white or tinted backgrounds. High speed production is made possible by the simplicity of Bruning BW machines—especially designed for ease of use, and without superfluous or confusing controls.

Q. How can I be sure my equipment is the right size?

A. BW equipment is designed for a wide range of print capacities. A Bruning Representative makes a thorough analysis of your specific print needs before recommending any machine. Bruning offers you a continuing service; makes sure the equipment you choose is *right.*

Q. What time-saving advantages will I have?

A. Bruning BW Prints save time three ways. First, the prints are delivered by your BW machine ready for use. Second, BW cut sheets—cut to the exact size of your tracings—eliminate time lost in trimming prints to size (although you may use roll stock if you prefer). Third, when changes are required in a series of BW Prints, but it is undesirable to alter the original tracing, a BW Intermediate Print is produced. Unwanted portions of the original design are deleted; new revisions are drawn on the BW Intermediate Print; and all subsequent BW Prints reproduced from the Intermediate will bear the new version.

BRUNING

CHARLES BRUNING COMPANY, INC.

Since 1897

NEW YORK • CHICAGO • LOS ANGELES

Atlanta • Boston • Cleveland • Detroit • Houston • Kansas City
Milwaukee • Newark • Pittsburgh • St. Louis • San Francisco • Seattle

Drafting Machines • Industrial Drawing Sets • Slide Rules • Erasing Machines • Refillable Draftsman's Pencils and many other products

CHARLES BRUNING COMPANY, INC.
4728-56 Montrose Avenue
Chicago 41, Illinois

Gentlemen: I want to know more about Bruning BW Prints and equipment. Please send me information.

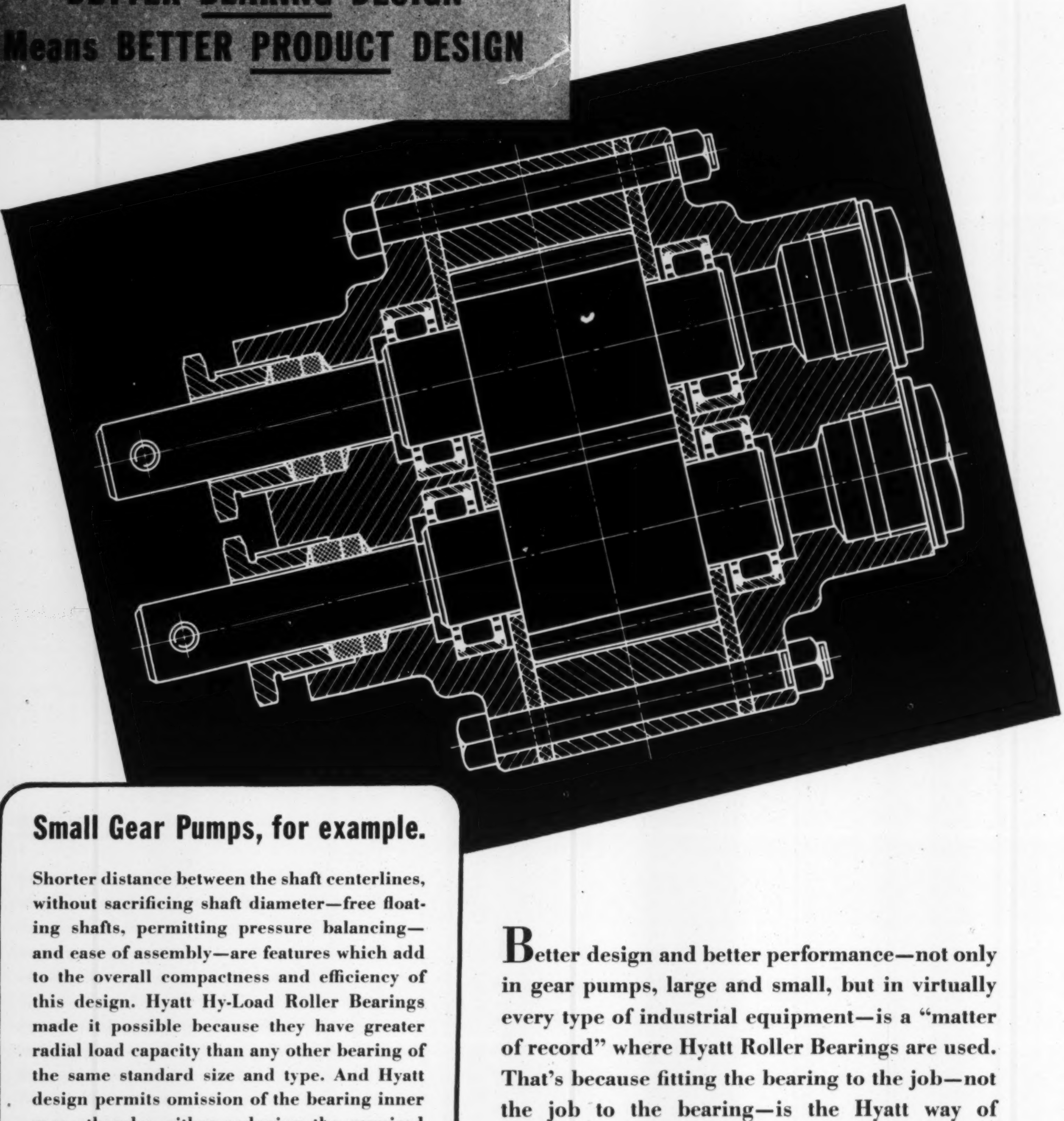
Name..............................

Company..............................

Street..............................

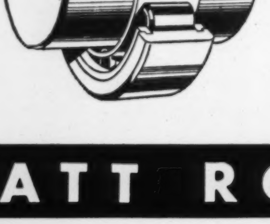
City.............................. *State*..............................

BETTER BEARING DESIGN
Means BETTER PRODUCT DESIGN



Small Gear Pumps, for example.

Shorter distance between the shaft centerlines, without sacrificing shaft diameter—free floating shafts, permitting pressure balancing—and ease of assembly—are features which add to the overall compactness and efficiency of this design. Hyatt Hy-Load Roller Bearings made it possible because they have greater radial load capacity than any other bearing of the same standard size and type. And Hyatt design permits omission of the bearing inner race—thereby, either reducing the required bearing O.D. space, and/or permitting the use of larger shaft.



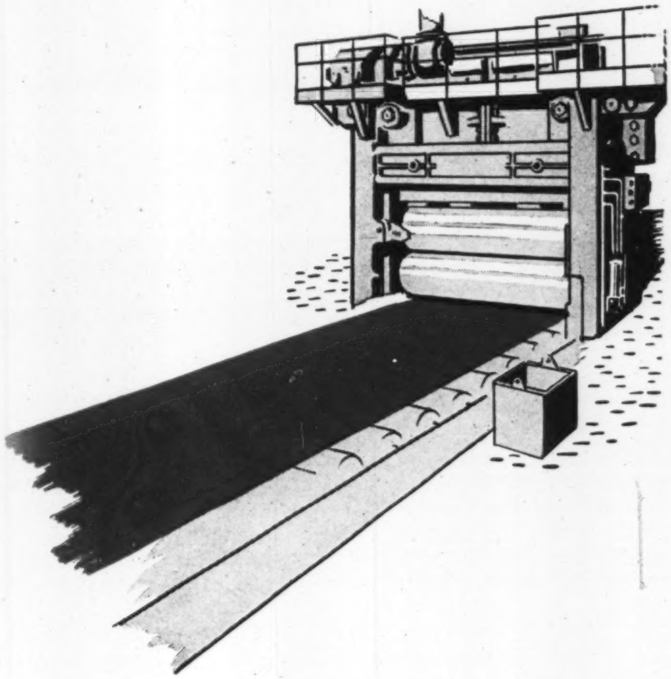
Better design and better performance—not only in gear pumps, large and small, but in virtually every type of industrial equipment—is a "matter of record" where Hyatt Roller Bearings are used. That's because fitting the bearing to the job—not the job to the bearing—is the Hyatt way of engineering.

Thus, when Hyatt Roller Bearings are built into a machine, you have the assurance that the bearing is planned, manufactured and applied for your specific requirements. Hyatt Engineering Service is at your disposal without cost or obligation. Address Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

$17,479 Saved in 11 Months

with Farval



FARVAL—*Studies in Centralized Lubrication*
No. 78

ROLL neck bearings in a steel plant in the Pittsburgh district were averaging 35,000 tons per bearing change. Re-babbitting cost $300 a set. Frequent bearing replacements cut production. Power and labor of oiling ran into substantial figures.

Farval engineers made a complete study of lubrication methods. Their analysis showed many savings possible with centralized lubrication. So Farval equipment to meet the plant's needs was installed.

After 11 months operation with Farval, carefully kept records showed the following savings:

Average bearing life increased from 35,000 to 163,000 tons

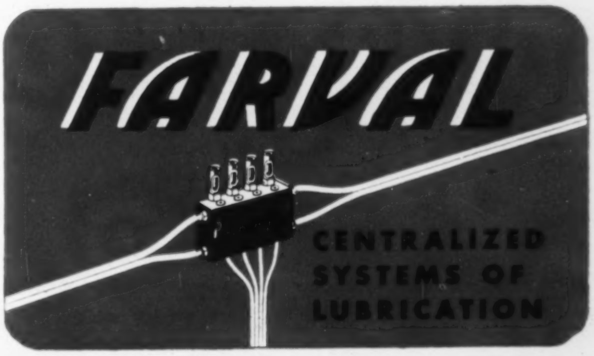
Savings of lubricant.........$	996.60
Oilhouse labor saved........	3,722.40
Power costs saved...........	11,410.00
Re-babbit costs saved........	1,350.00
Total savings............	$17,479.00

In addition to these substantial savings, the elimination of mill delays and shutdowns for bearing replacements provided even greater savings through increased production.

Farval delivers oil or grease under pressure to a group of bearings from one central station, in exact quantities, at regular intervals. Farval—the Dualine System with the Positive Piston Displacement Valve—that has but 2 Moving Parts—is Fully Adjustable—and with a Tell-tale indicator at each bearing to show the job is done.

Savings comparable to the above can be made on your equipment with Farval. Write for Bulletin 25. The Farval Corporation, 3264 East 80th St., Cleveland 4, Ohio.

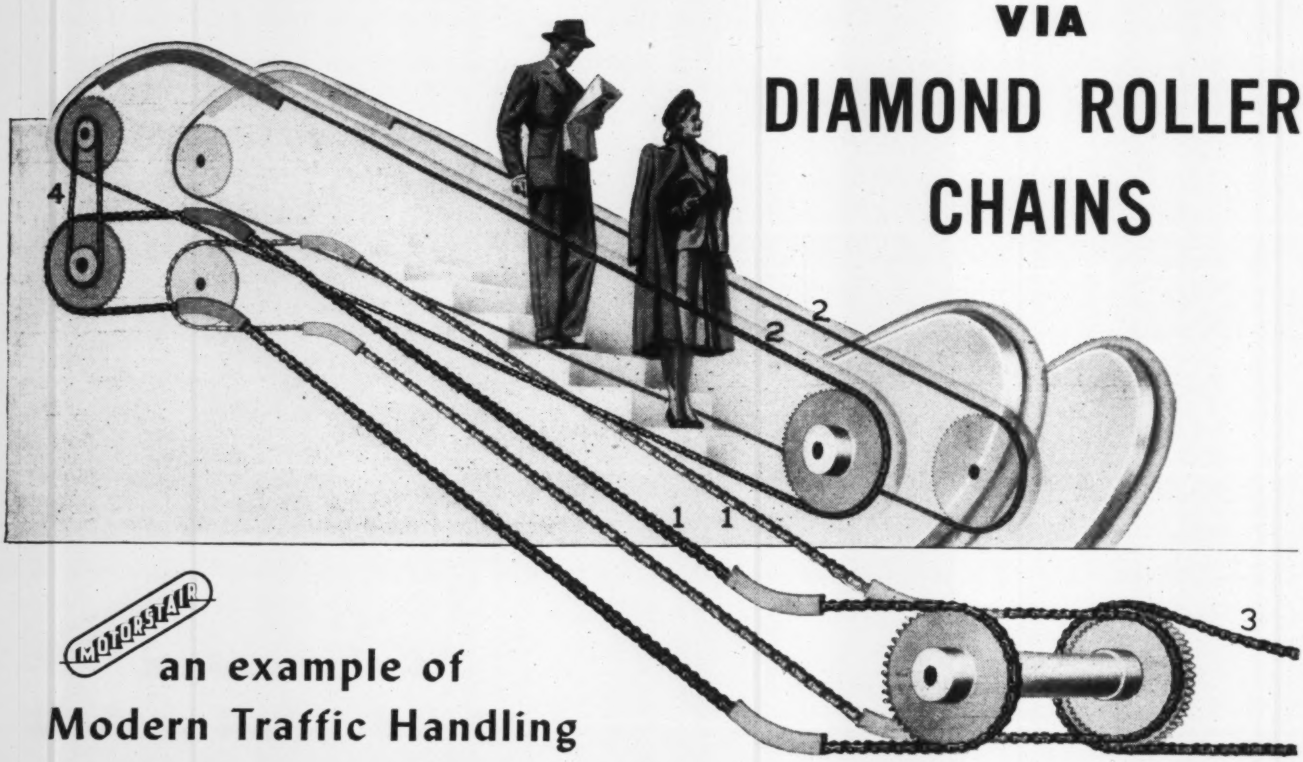
Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited



FLOOR-TO-FLOOR TRANSPORTATION

VIA

DIAMOND ROLLER CHAINS



MOTORSTAIR

an example of Modern Traffic Handling

● Effortless and safe floor-to-floor transportation is becoming more and more vitally important in stores, hotels, banks, passenger terminals, and similar buildings where traffic is heavy. To help meet that need, Diamond Roller Chains were selected by the manufacturer of the new "Motorstair" to handle such transportation.

Quietly, smoothly and safely, with lasting dependability, the steps of this Multiscope "Motorstair"—the MODERN MOVING STAIRWAY—can transport 3000 people per hour. *Transmitting power* to the steps and handrails, and *carrying* the steps and handrails, the six DIAMOND Roller Chains function with unfailing dependability and economy.

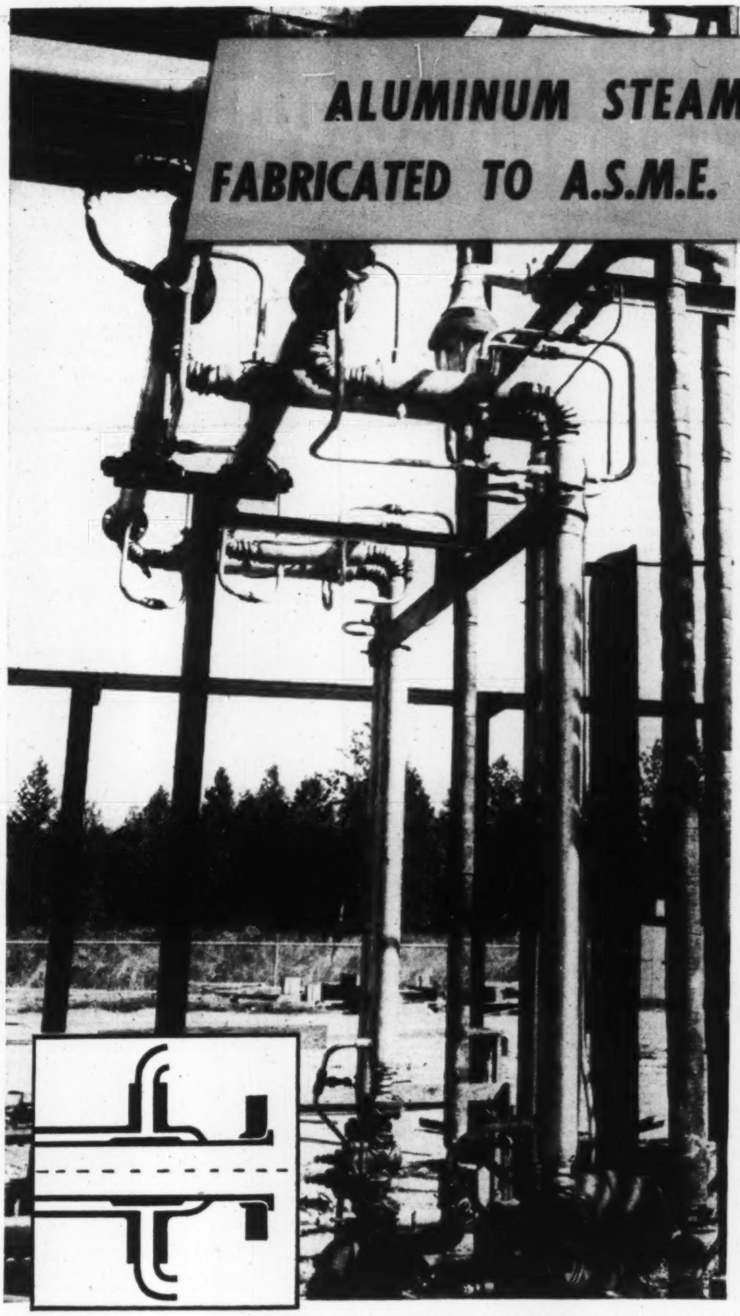
While "Motorstair" is a new development, Diamond Roller Chains have operated both for conventional applications as power drives and for special applications on leading makes of machinery and equipment for over a half century. . . . To save time in arriving at practical usages, Diamond engineering cooperation is available at all times. DIAMOND CHAIN COMPANY, Inc., Dept. 413, 402 Kentucky Avenue, Indianapolis 7, Indiana. *Offices and Distributors in All Principal Cities.*

Two sturdy DIAMOND ROLLER CHAINS, (1) (1), carry the Motorstair steps. Chains for endless aluminum handrails, (2) (2), move at the same rate of speed as the step chains. In addition DIAMOND CHAINS, (3) and (4) drive from motor to step chains and from step chains to handrail chains.

96-page Catalog 617 on modern drives will be mailed on request.

DIAMOND ROLLER CHAINS

ALUMINUM STEAM JACKETED LINES FABRICATED TO A.S.M.E. BOILER CODE FOR STEEL



"It couldn't be done"... but Grinnell Metallurgical Research did it.

● These *aluminum* steam jacketed lines with jumper connections and tracing lines were designed by Stone & Webster Engineering Corporation for Newport Industries of Oakdale, Louisiana. The specifications called for fabrication procedure to meet Section IX of the A.S.M.E. Boiler Construction Code for *steel*—a most unusual and strict requirement.

Experts said the job couldn't be done, but Grinnell metallurgical research developed processes for forming, drawing and welding *aluminum* to meet the requirements of a code intended for *steels.* Again Grinnell does an "impossible" job—on time—with sub-assemblies ready for installation with minimum field welding.

GRINNELL PREFABRICATION
Combines
MODERN RESEARCH INTERPRETIVE ENGINEERING
SPECIALIZED PERSONNEL & FACILITIES

Quality and economy are assured because of one source for design and fabrication; pretesting and approval before shipment; only completed assemblies are billed at predetermined prices; delivery schedules can be predetermined but kept flexible; field assembly time is materially reduced.

A TYPICAL EXAMPLE OF GRINNELL PIPING SERVICE

COMPLETE . . . . . . EVERYWHERE

PIPING SUPPLIES

- Pipe, Valves and Fittings
- Engineered Pipe Hangers
- Grinnell-Saunders Diaphragm Valves
- Thermolier Unit Heaters
- Prefabricated Piping
- Plumbing and Heating Specialties
- Oil, Water Works and Industrial Piping Supplies

OTHER GRINNELL PRODUCTS

Automatic Sprinklers and Special Hazard Fire Protection Systems

AMCO Humidification and Cooling Systems

SEATTLE
SACRAMENTO
OAKLAND
SAN FRANCISCO
FRESNO
LOS ANGELES
LONG BEACH
MINNEAPOLIS
ST. PAUL
MILWAUKEE
CHICAGO
CLEVELAND
PROVIDENCE
NEW YORK
PHILADELPHIA
KANSAS CITY
ST. LOUIS
CHARLOTTE
ATLANTA
HOUSTON

GRINNELL COMPANY, INC.
Executive Offices
PROVIDENCE 1, RHODE ISLAND

GRINNELL

WHENEVER **PIPING** IS INVOLVED

Get "solid" metal protection with clad steel economy...; the Lukens way!

Jacketed food cookers of Lukens Nickel-Clad Steel under fabrication in the plant of Leader Iron Works, Inc., Decatur, Ill. Each cooker measures 6′0″ in diameter by 3′7″ deep.

Have you considered this?

Where one surface is exposed to corrosive attack, a Lukens Clad Steel will give you the same protection offered by the solid corrosion-resistant metal. Yet the cladding of corrosion-resistant metal comprises only 10 per cent or other small fraction of the total plate thickness, as your service requires.

Lukens Clad Steels include Nickel-Clad, Stainless-Clad, Inconel-Clad and Monel-Clad—the widest range of clad steels available to industry. Backing plates can be any steel of ASME quality.

Manufactured by Lukens method, the bond between cladding and backing plate is permanent, the thickness of cladding uniform. Available in plates up to 178″ wide, or from $\frac{3}{16}$″ to over 3″ thick. Commercial methods of welding, bending, shearing or pressing are employed.

Let our engineers help you gain solid metal corrosion protection with the economy which clad steels make possible. Complete information on Lukens Stainless-Clad Steels is contained in Bulletin 338; on Nickel-Clad, Inconel-Clad and Monel-Clad in Bulletin 255. Lukens Steel Company, 402 Lukens Building, Coatesville, Penna.

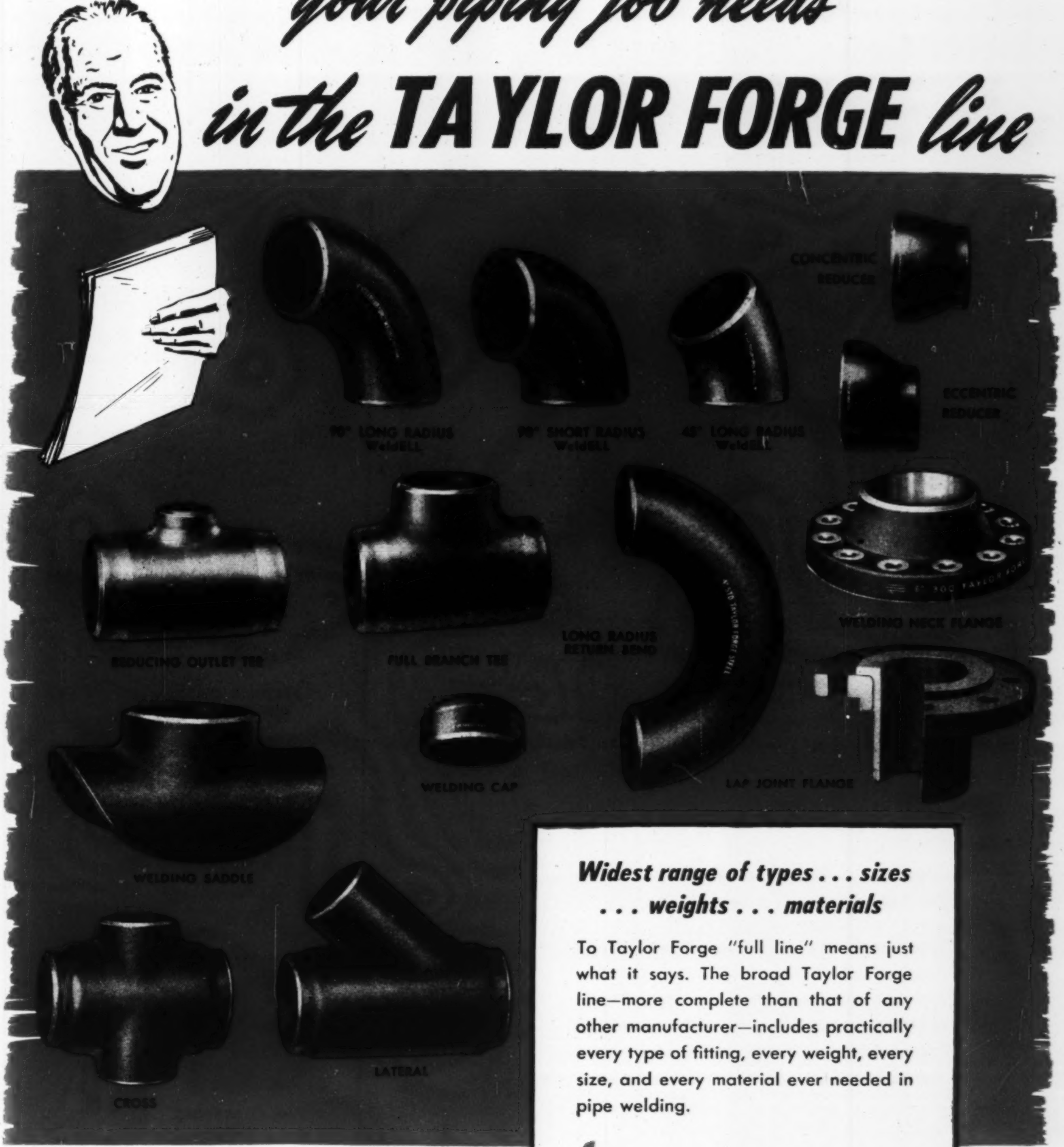
LUKENS
Nickel-Clad Stainless-Clad
Inconel-Clad Monel-Clad
STEELS

SOLID METAL ADVANTAGES WITH CLAD STEEL ECONOMY

...You get everything...

your piping job needs

in the TAYLOR FORGE *line*


90° LONG RADIUS WeldELL
90° SHORT RADIUS WeldELL
45° LONG RADIUS WeldELL
CONCENTRIC REDUCER
ECCENTRIC REDUCER
REDUCING OUTLET TEE
FULL BRANCH TEE
LONG RADIUS RETURN BEND
WELDING NECK FLANGE
WELDING CAP
LAP JOINT FLANGE
WELDING SADDLE
LATERAL
CROSS

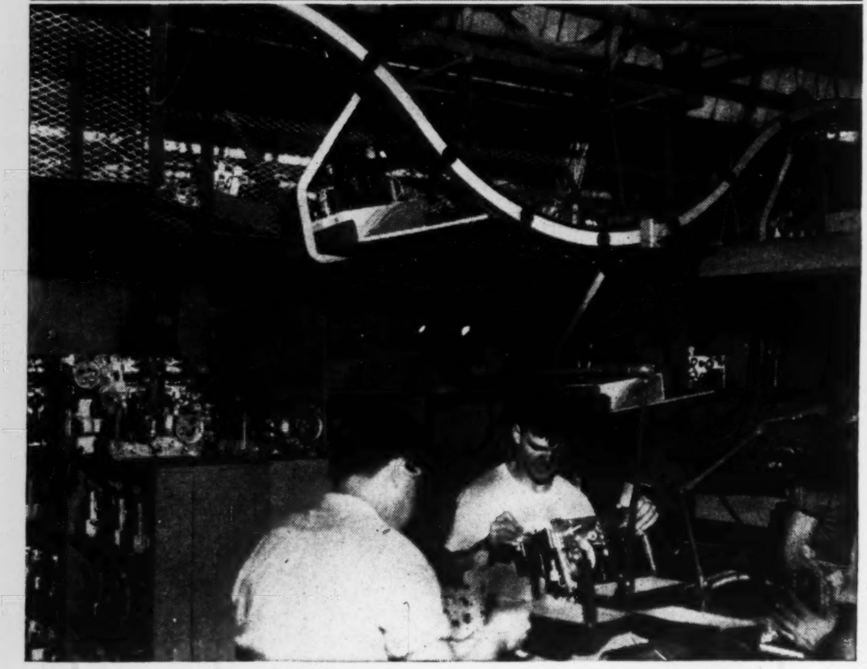
Widest range of types . . . sizes . . . weights . . . materials

To Taylor Forge "full line" means just what it says. The broad Taylor Forge line—more complete than that of any other manufacturer—includes practically every type of fitting, every weight, every size, and every material ever needed in pipe welding.

Yes, Weldells have everything

TAYLOR FORGE
& PIPE WORKS
General Offices & Works: Chicago 90, Ill. (P.O. Box 485)
EASTERN PLANT: CARNEGIE, PA.
DISTRICT OFFICES
New York: 50 Church Street Philadelphia: Broad Street Station Bldg.
Chicago District Sales: 208 S. LaSalle Street
Houston: City National Bank Bldg. Los Angeles: Subway Terminal Bldg.

LINK-BELT *Engineered* OVERHEAD TROLLEY CONVEYORS MAKE CEILINGS PAY DIVIDENDS



Link-Belt overhead trolley conveyors provide a steady and uniform flow of parts or finished products from one point to another. They do this without occupying valuable floor space, and the path of travel may follow any desired route, on any level.

Aside from transportation, this type of conveyor may serve actual processing functions, such as drying or cooling of parts in transit, and the positive coordination of different stages in production procedure. Time, labor, space and costs are saved, efficiency is promoted by overhead trolley conveyors, built and engineered by Link-Belt Conveyor specialists.

LINK-BELT COMPANY

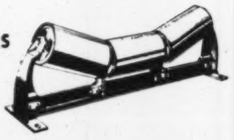
Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5,
San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8.
Offices, Factory Branch Stores and Distributors in Principal Cities. 10,962

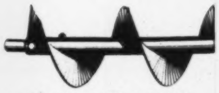
LINK-BELT

CONVEYING MACHINERY

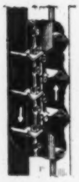
THE COMPLETE LINE OF LINK-BELT CONVEYING MACHINERY

BELT CONVEYORS

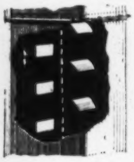




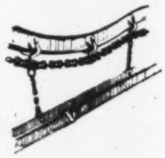
SCREW CONVEYOR



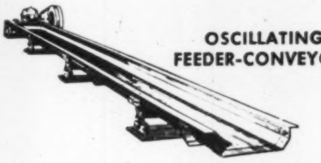
BULK-FLO Elevator-Feeder Conveyor



BUCKET ELEVATORS

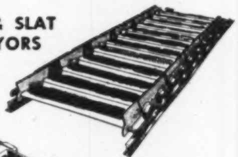


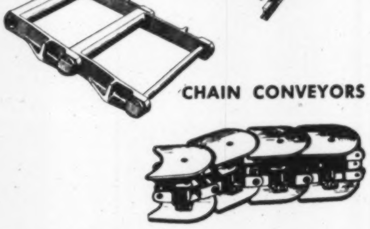
OVERHEAD CONVEYORS



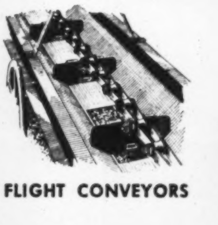
OSCILLATING FEEDER-CONVEYORS

APRON & SLAT CONVEYORS

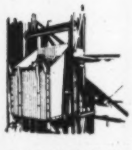




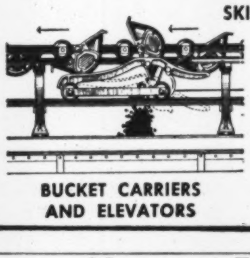
CHAIN CONVEYORS



FLIGHT CONVEYORS



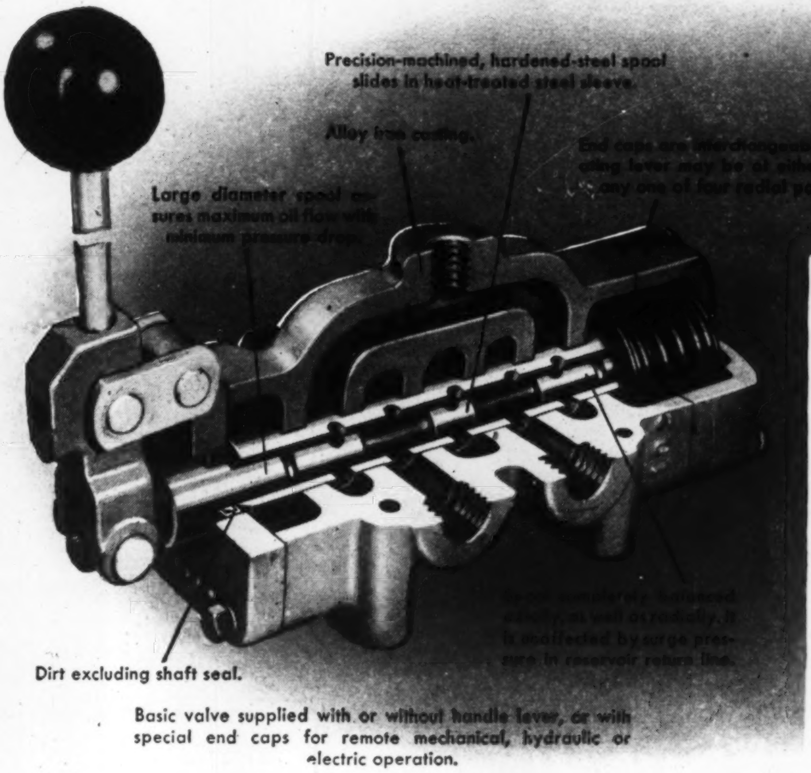
SKIP HOISTS



BUCKET CARRIERS AND ELEVATORS

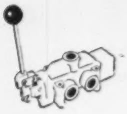
THE *Under-Cover Features* OF THE

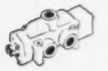
New Adel Hydraulic Selector Valve


Precision-machined, hardened-steel spool slides in heat-treated steel sleeve.
Alloy iron casting.
End caps are interchangeable. Operating lever may be at either end at any one of four radial positions.
Large diameter spool assures maximum oil flow with minimum pressure drop.
Spool completely balanced axially, as well as radially. It is unaffected by surge pressure in reservoir return line.
Dirt excluding shaft seal.
Basic valve supplied with or without handle lever, or with special end caps for remote mechanical, hydraulic or electric operation.

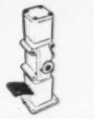
Unlimited flexibility...quiet, shockless operation ...low pressure drop...long, dependable service! These are the operating characteristics of the new ADEL line of hydraulic oil control valves. Simple, spool-type construction permits wide variety of porting arrangements for either open-center or closed-center hydraulic systems. Standard 4-way valves available with spring-centered, spring-offset, or three position detent action. Manufactured in ¼″, ⅜″, ½″, ¾″ and 1″ pipe thread port sizes for 1000 psi service. Flows to 32 gpm.

ADEL OFFERS 4-WAY VALVES IN A VARIETY OF MODELS TO MEET ALL OPERATING CONDITIONS

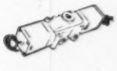

Lever Operated 4-Way Valve For Manual Control


Mechanically-Operated, 4-Way Valve For Remote Manual Control

Pilot-Operated 4-Way Valve For Remote Hydraulic Control


Single Treadle 4-Way Valve For Foot Control

6, 12 or 24 Volt DC Solenoid-Operated 4-Way Valve For Remote Electrical Control


110 AC Solenoid-Operated 4-Way Valve For Remote Electrical Control

Cam-Roller Operated 4-Way Valve For Automatic Control

Write for new descriptive bulletin containing detailed information on ADEL'S complete line of industrial hydraulic pumps, valves, cylinders, power packs, etc. Please address inquiries to 10748 Van Owen Street, Burbank, California.

ADEL

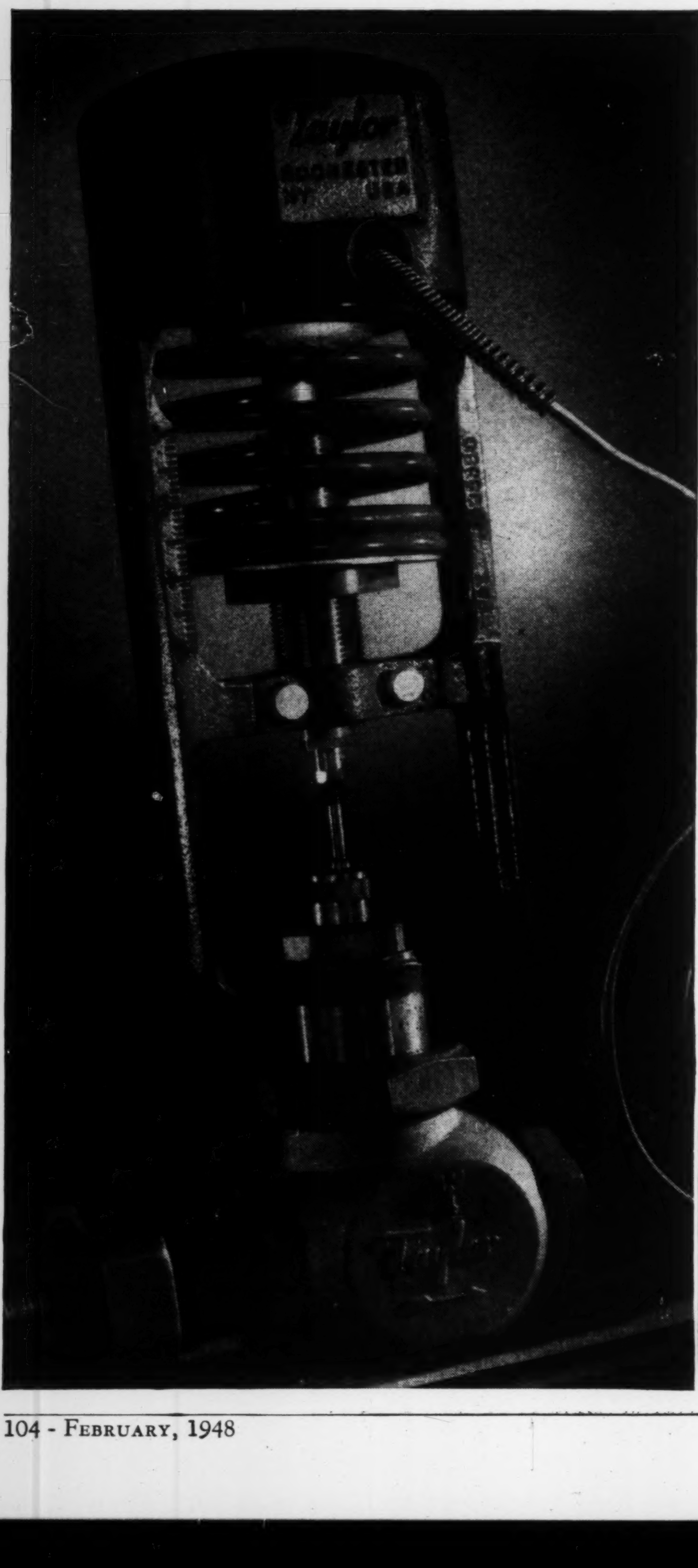
ADEL PRECISION PRODUCTS CORP.

BURBANK, CALIF.   HUNTINGTON, WEST VIRGINIA

Manufacturers of: **Aircraft Hydraulic Systems • Marine & Industrial ISOdraulic Controls • Halfco Self-Aligning Bearings • Line Support Clips and Blocks • Industrial Hydraulic Equipment • Aircraft Valves • Industrial Valves**

IMMEDIATE DELIVERY

on Taylor Self-Acting Temperature Controllers!



IT'S A FACT! We can now offer you immediate delivery on the dependable Taylor Self-Acting Controllers. Simple in operation—practically no maintenance required.

Perfect for processes involving no extreme load changes, and where compressed air or electricity aren't available. Jobs like: crude oil treaters, condenser cooler water in stills, oil field superheaters, wax coating machines, plating and rinsing tanks, bottle and can washers, mixing and cooling kettles, hot water tanks, diesel water jackets, feed water systems, etc.

No auxiliary air supply required. Double seated valves available up to 2″; single seated composition disc types up to 1″. Numerous standard temperature ranges within 10° to 340° F., and semi-standard temperature ranges within 165° and 610° F.

Ask your Taylor Field Engineer or write for Catalog 36-R. Taylor Instrument Companies, Rochester, N.Y., or Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.

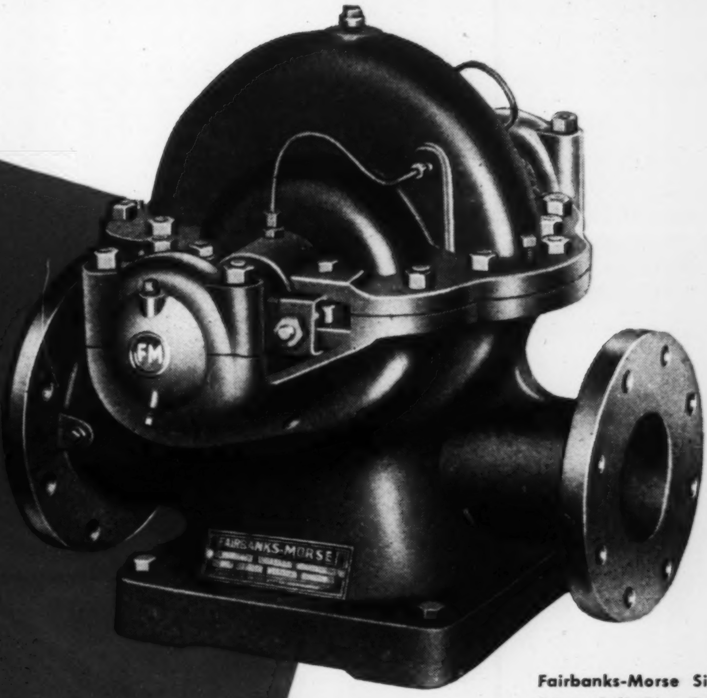
Taylor Instruments

MEAN

ACCURACY FIRST

IN HOME AND INDUSTRY

Why use two stages when ***ONE*** will do?



Fairbanks-Morse Single-Stage, Split Case Centrifugal Pump—for dependable, high-speed service.

When your job demands a multi-stage pump, the Fairbanks-Morse pump expert will recommend the right one from among the broad line built by *his* company . . .

But—frequently he can help you save the cost of a more expensive unit by recommending one of these single-stage, split-case pumps . . . whose performance, where heads reach toward 300 feet and capacities range to 72,000 g.p.h., is often equal to that of more costly multi-stage pumps.

Without prejudice, he can find for you the pump that suits your needs best; for in the Fairbanks-Morse line, he has all types, all sizes.

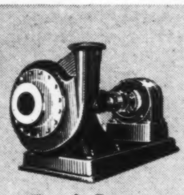
When it comes to pumps...

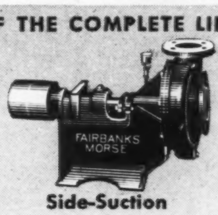
FAIRBANKS-MORSE

A name worth remembering

DIESEL LOCOMOTIVES • DIESEL ENGINES • STOKERS • SCALES MOTORS • GENERATORS • PUMPS • RAILROAD MOTOR CARS and STANDPIPES • FARM EQUIPMENT • MAGNETOS

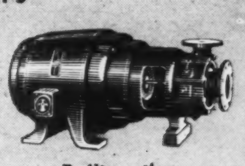
A FEW OF THE COMPLETE LINE OF FAIRBANKS-MORSE PUMPS


Trash Pumps



Side-Suction

Rotary


Builtogether

TRANSACTIONS OF THE A.S.M.E.—This magazine will be published on the tenth of every month except March, June, September, and December. Its articles will be selected from papers presented at A.S.M.E. national meetings and will cover outstanding developments in the fields of aviation, fuels; graphic arts, heat transfer, hydraulics, industrial instruments and regulators, management, materials handling, metals engineering, oil and gas power, process industries, production engineering, power, railroad, rubber and plastics, textile, and wood industries. Discussions embodying comments, criticisms and experiences of other engineers will be included, also progress reports of A.S.M.E. research committee.

Subscription price $8.00 annually; $4.00 to A.S.M.E. members.

Combination price for the Transactions of the A.S.M.E. and the Journal of Applied Mechanics $12.00 annually; $6.00 to A.S.M.E. members.

APPLIED MECHANICS REVIEWS—This new monthly scientific Journal meets the need for a comprehensive review of current literature in the field of applied mechanics. To insure readers of world-wide coverage, Applied Mechanics Reviews will cull the output of some 500 magazines here and abroad, but will report, analyze, and review only those of greatest significance. These reviews, each about 500 words in length, will be written and signed by authorities. They will deal with important theoretical and experimental papers on solid mechanics, fluid mechanics, thermodynamics, and heat transfer, as well as applications of these to geophysics and to such specialized subjects as soil mechanics, acoustics, ballistics and lubrication.

Subscription price $12.50 annually; $9.00 to A.S.M.E. members.

JOURNAL OF APPLIED MECHANICS—This publication will continue to be published in the months of March, June, September, and December.

As in the past, it will keep readers informed of important developments in the fields of general mechanics, elasticity, hydrodynamics, aerodynamics, strength of materials, stress analysis, thermodynamics, plasticity, fluid dynamics and vibration. Discussions giving views, opinions and criticisms of other engineers will be included. The Design Data section with its concise presentation of data and information drawn chiefly from papers previously published in this magazine, will be continued, as well as reviews of books of interest to designers, research workers and others practicing in this field.

Subscription price $5.00 annually; $2.50 to A.S.M.E. members

MAKE SURE OF RECEIVING THESE PUBLICATIONS BY MAILING THIS ORDER FORM NOW, WHILE THE MATTER IS BEFORE YOU.

A.S.M.E. Publication-Sales Department
29 West 39th St., New York 18, N. Y.

Gentlemen: Please enter the following subscriptions for 1948 (Indicate by chec publications wanted.):

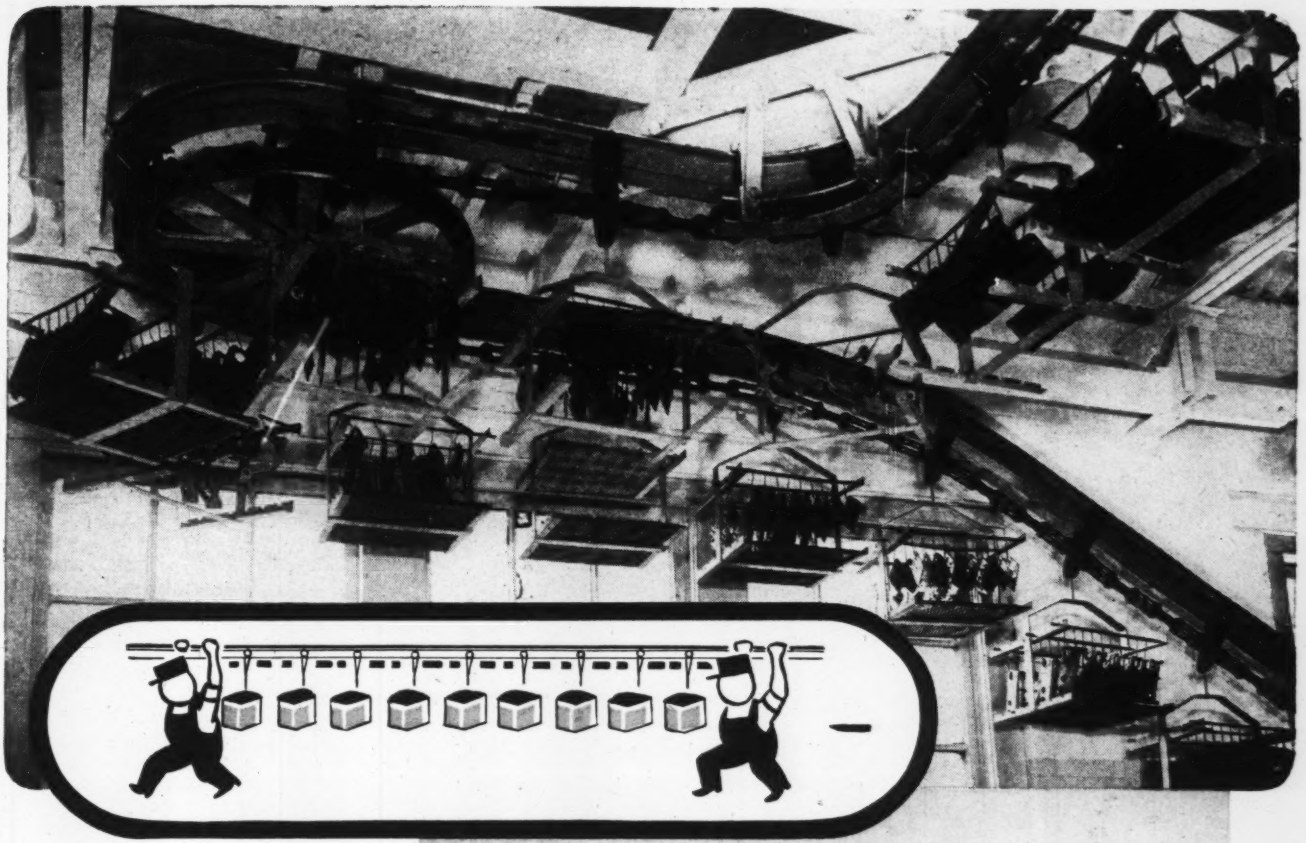
- —JOURNAL OF APPLIED MECHANICS (4 issues) $5.00 annually; $2.50 to A.S.M.E. Members.
- —TRANSACTIONS OF THE A.S.M.E. (8 issues) $8.00 annually; $4.00 to A.S.M.E. Members.
- (Combination price for Transactions of the A.S.M.E., and Journal of Applie Mechanics, $12.00 annually; $6.00 to A.S.M.E. Members.
- —APPLIED MECHANICS REVIEWS (12 issues) $12.50 annually; $9.00 to A.S.M.E. Members.

NAME______________________________

ADDRESS______________________________

CITY________________ZONE NO.______STATE________

(Please state if_____member_____nonmember.) Date__________



WHEN MATERIALS GO OVERHEAD OVERHEAD COSTS GO DOWN

There's a close link between overhead costs and overhead trolley conveying systems as designed and built by Gifford-Wood. There's the safety assurance when work in process and finished materials travel overhead the G-W way: men are far less liable to get hurt and require costly time off. There's the increase in floor space made available by relieving congested work areas when you let G-W install an arrangement of automatic overhead trolley conveyors. Carriers and hooks are designed to fit specific products.

What's more, in addition to overhead trolley systems, G-W supplies other types of material-handling equipment—apron, flight, chain, belt and screw conveyors, carriers and elevators. For G-W is a material handling specialist, with more than 130 years' experience in making materials move—the fast, safe, space-saving way. That's evidence aplenty that G-W can solve any material handling problem. Yours, for example!

GIFFORD-WOOD CO.
420 LEXINGTON AVENUE, NEW YORK 17, N. Y.
565 W. WASHINGTON STREET, CHICAGO 6, ILL.
***Factory:* Hudson, N. Y.**

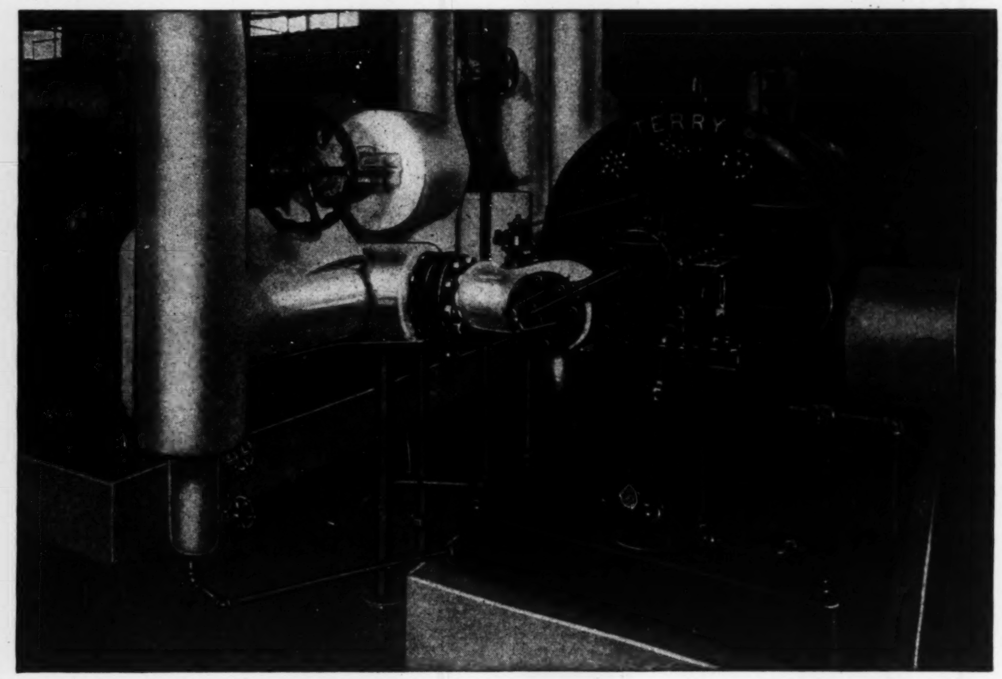
Even if your problem is unique, G-W will design a conveying-elevating system to meet your requirements. Whether your product is large or small, G-W systems fitted to your plant layout can move it faster, easier, cheaper.

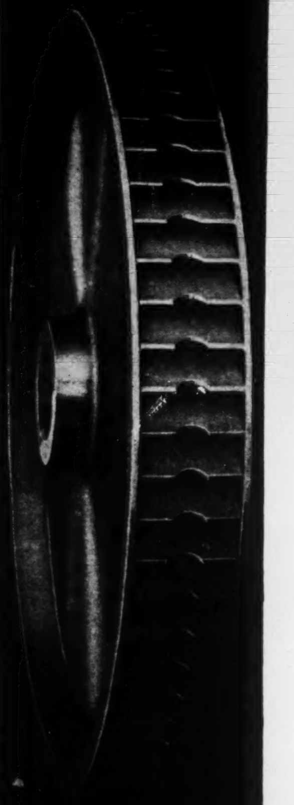
1813

G-W HANDLES IT...
faster • easier • cheaper

GIFFORD-WOOD
SINCE 1814

TERRY





GENEROUS BLADE CLEARANCES
IN THIS 900° TERRY WHEEL TURBINE
INCREASE DEPENDABILITY . . . .

The 290 H. P. Terry Turbine shown above is used for Boiler Feed Pump Drive in a recently completed central station. It operates with steam at 850 lbs.-900° F. and employs a Terry one piece wheel, as illustrated at the left.

The blades of this Turbine have large radial and axial clearances. They are further protected by projecting rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the radial clearance became reduced. It is therefore impossible for the blades to foul.

The side clearance is very large - one inch - so that end play can do no damage.

Such construction makes for dependable operation.
- Descriptive bulletins sent on request. Ask for S-116.

T-1167

THE TERRY STEAM
TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

D.O.James

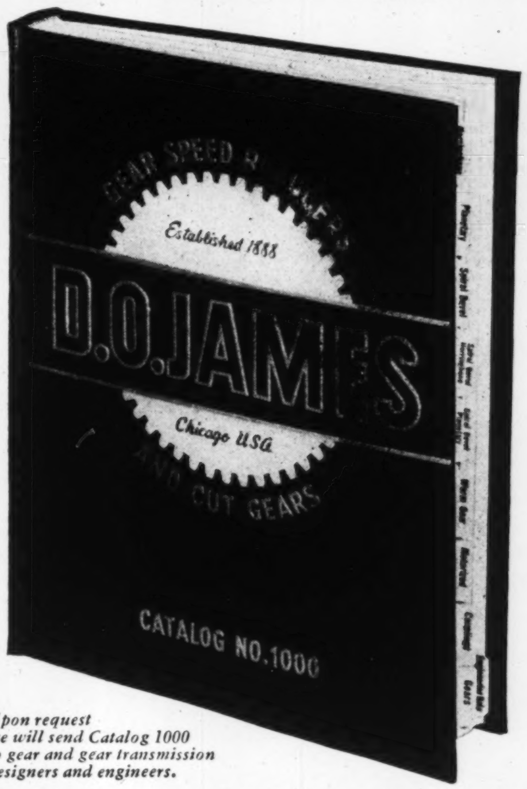
Established 1888

POWER SAVING PRODUCTS

CATALOG No. 1000

It's new and complete . . . and contains the latest information available

On the Engineering and Manufacture of Gears and Gear Reducers, Racks and Flexible Couplings



Upon request we will send Catalog 1000 to gear and gear transmission designers and engineers.

This 575 page indexed catalog contains essential practical information that will assist in solving gear and gear transmission problems. The contents of Catalog 1000 include extensive engineering data, rating tables, recommended practices for speed reducer selection, horsepower capacities of gears with examples, dimensions and list prices – also general information on design, construction and application of various types of cut gears, gear speed reducing transmissions and flexible couplings.

IMPORTANT ENGINEERING DATA—Contains 100 pages of engineering data that is invaluable—compiled and obtained from various accredited sources. Includes tables, charts and formulas that are useful and helpful in gear design problems.

D.O.JAMES MANUFACTURING COMPANY
1140 WEST MONROE STREET · CHICAGO (7), ILLINOIS

MAKERS OF EVERY TYPE OF GEAR AND GEAR REDUCER

What are Plant Engineers Talking About NOW...?

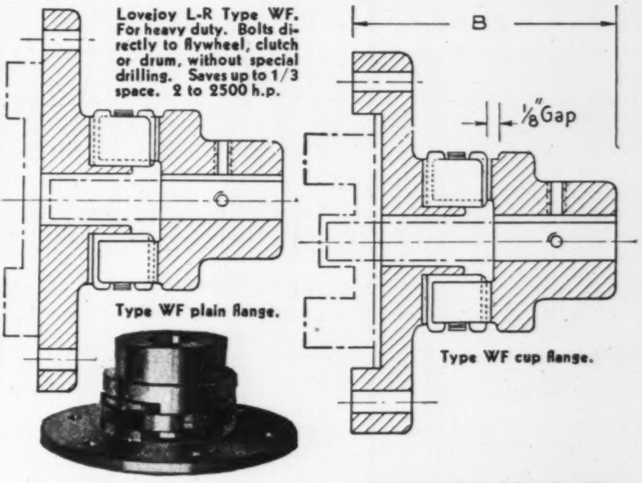
...INCREASED LOADS

Demands on power—how to provide adequate means for today's requirements.

Here's One Way: Insure *full*, truer, smoother power flow from either present or new equipment with

LOVEJOY L-R Flexible Couplings

Correct for misalignment, oscillation, backlash, chatter. Take up shock and vibration. Lovejoy couplings *require no lubrication.* (That's *another* subject that has come to the fore.) Cushions always in sight. NO TEAR-DOWNS FOR CHANGING.



Lovejoy L-R Type WF. For heavy duty. Bolts directly to flywheel, clutch or drum, without special drilling. Saves up to 1/3 space. 2 to 2500 h.p.

Type WF plain flange.

Type WF cup flange.

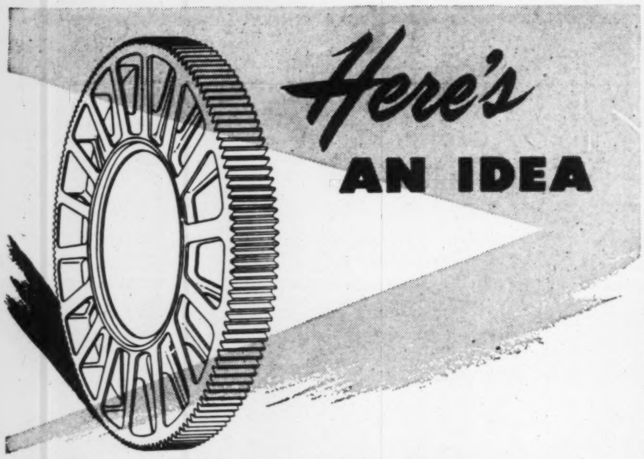
Pat. & Pats. Pend.

SEND FOR COMPLETE LOVEJOY CATALOG

Shows couplings *for every kind of duty*, 1/6 to 2500 h.p. Also brings you Lovejoy's BIG HELP, Quick-Finding Selector Charts that lead you right to the couplings you need, with complete engineering data and prices right at hand. Should be in every plant engineer's file. Wire or write

Mfd. by

LOVEJOY Flexible Coupling Co.
5032 W. Lake St., Chicago 44, Ill.
Also mfrs. of Lovejoy Variable Speed Controls



WE make gears, racks, speed reducers and special machinery for bridges, dams and similar types of construction. We make gears of any practical material in sizes ranging from inches up to 30 feet in diameter.

And, we believe the way to sell our gears is by giving you exactly the kind of work you want. We believe that's good business.

We also believe that it's good business for you to buy gears where you will get exactly what you want—made exactly to your specifications.

That's why we think it's a good idea for you to ask Earle for estimates on your work. The Earle Gear and Machine Company, 4712 Stenton Ave., Philadelphia 44, Pa.; Sales Offices: 149 Broadway, New York 6, N. Y.; 901 Davis Ave., Pittsburgh 12, Pa.

IT'S GOOD BUSINESS
TO DO BUSINESS WITH
Earle

EARLE GEARS

PRECISION TOOLS

Drawing Instruments
Stainless Steel T-Squares—
Straightedges & Triangles.

Catalog on request

THEO. ALTENEDER & SONS
Established 1850
1217 Spring Garden Street
Philadelphia 23, Pa.

MECHANICAL ENGINEERING
CARD INDEX

January, 1948 **Vol. 70, No. 1**

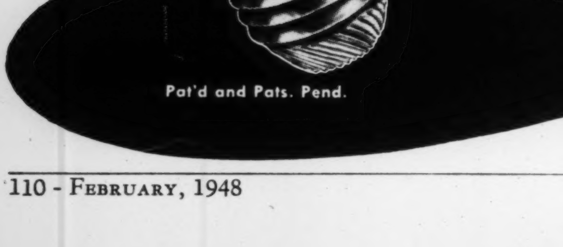
Accent on Youth, E. W. O'Brien 5
Atomic Energy and the Engineer, D. E. Lilienthal 8
Heat Transfer in Industry, C. E. Lucke 11
Employer Practice Regarding Engineering Graduates—Supplement Report 13
ASME 1947 Annual Meeting Preprints 38
To ASME Members: The Council Reports for 1947 41
Atlantic City Scene of 1947 ASME Annual Meeting 49
Editorial 3
Briefing the Record 17
ASME Technical Digest 35
Comments on Papers 75
Reviews of Books 80
ASME Boiler Code 82
ASME News 83
ASME Junior Forum 91
Contents of ASME Transactions 108

HALLOWELL *Steel Collars*

"Hallowell" Solid Steel Collars, attractively proportioned throughout, are precision-machined so faces run perfectly true . . . are also highly polished all over . . . yet they cost less than common cast iron collars. 3" bore and smaller are made from Solid Bar Stock and fitted with the famous "Unbrako" Knurled Point Self-Locking Socket Set Screw . . . a set screw that, once tightened holds and stays tight to make sure the collar won't shift on the shaft. "Hallowell". . a "buy word" in shaft collars . . . available in a full range of sizes for

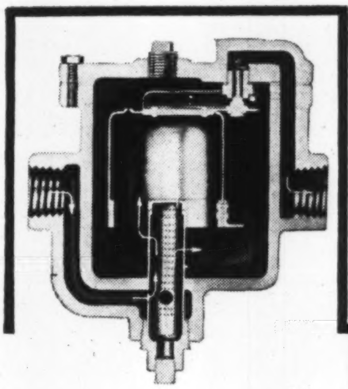
IMMEDIATE DELIVERY

"Unbrako" and "Hallowell" Products are sold through Industrial Distributors.



Pat'd and Pats. Pend.

OVER 45 YEARS IN BUSINESS
STANDARD PRESSED STEEL CO.
JENKINTOWN, PA. BOX 558
BOSTON • CHICAGO • DETROIT • INDIANAPOLIS • ST. LOUIS • SAN FRANCISCO



SARCO
Inverted
Bucket
Steam
TRAPS

Sarco Bucket Traps handle large volumes of condensate very rapidly, and can be built for the highest commercial steam pressures. The inverted bucket operates a simple valve mechanism of great power. Valve is protected by a Sarco Strainer built right into the trap. Can be equipped with thermostatic air by-pass for rapid and complete elimination of air and gas.

Standard sizes ½ to 2 in., 10 to 150 lbs. and 10 to 250 lbs. Forged steel types for pressures to 900 lbs. and for superheat. Catalog 350.

209

SARCO
SAVES STEAM

SARCO COMPANY, INC.
Empire State Bldg., New York 1, N.Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO

YOU GAIN BY GETTING BOTH FROM BROWNELL

When you have a BROWNELL MATCHED UNIT, only one manufacturer is accountable for both the boiler and the stoker. There's no division of responsibility. More than that, you know that you have good heating equipment—with a great reputation back of it.

A BROWNELL MATCHED UNIT gives you all the benefits of mechanical firing . . . smokeless combustion; automatic regulation; fuel economy; saving of time, labor, and worry.

Brownell boilers and stokers offer you a wide range of selection to meet your requirements. Along with Brownell equipment goes competent engineering service.

The Brownell agent in your vicinity will be glad to give you full information. If you don't know his name and address, write us.

THE
BROWNELL COMPANY
446 N. FINDLAY ST.
DAYTON 1, OHIO

BROWNELL MATCHED UNIT of Low Pressure Boiler and Worm-Type Underfeed Stoker.

How you can REPAIR CONCRETE FLOORS QUICKLY

Quick FLOOR PATCH CEMENT
SMOOTH-ON
No. 7B
REPAIRS
HOLES · RUTS · CRACKS
IN CEMENT FLOORS

Fill up cracks, ruts, shallow holes, uneven spots, etc., in concrete floors with Smooth-On No. 7B Quick Floor Patch Cement. The patch will harden quickly, adhere strongly to an old floor, and is ready for use as soon as it is hard.

Anyone can apply Smooth-On No. 7B by following the simple directions that come with it. The patches will stay tight, because Smooth-On No. 7B expands slightly as it hardens and wedges the patch securely in place.

Order Smooth-On No. 7B Quick Floor Patch Cement in 5-, 25- or 100-lb. size.

FREE FLOOR PATCH FOLDER AND METAL REPAIR HANDBOOK

Folder gives full information on Smooth-On No. 7B Quick Floor Patch Cement. With it we'll send you the famous 40-page Smooth-On Repair Handbook, full of time-saving, money-saving repairs on plant and home equipment. Send now.

SMOOTH-ON CEMENTS
Motor Car and Boat
Home Factory and
Power Plant

----*Sign and Send TODAY*----

Smooth-On Mfg. Co., Dept. 56B
570 Communipaw Ave.,
Jersey City 4, N. J.

Please send me QUICK PATCH FOLDER AND HANDBOOK.

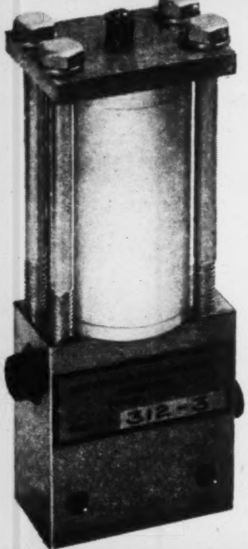
Name..

Address..

2-48
....

Do it with **SMOOTH-ON**
QUICK FLOOR PATCH CEMENT

A Dependable SOLENOID VALVE



An inexpensive, compactly built unit, suitable for all hydraulic systems, or for the handling of any non-corrosive fluids.

Specifications:

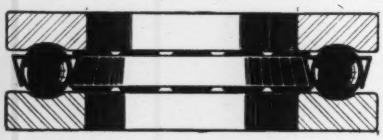
- Two-way; normally closed.
- Maximum working pressure, 3000 P.S.I.
- Electrical requirements: 6, 12, 24, or 36 volts D.C.
- Low current consumption: 2.3 amperes at 12 volts.
- Positive locking of fluid in one direction. Free flow in the other direction.
- 3/8" NPT parts.
- Also available with integral flow rate regulation.

Other Waterman Products:

- Constant Flow Regulators
- Variable Flow Regulators
- Lo-Flo Fuses
- Selector Valves

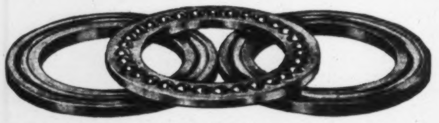
WATERMAN ENGINEERING *Company*

721 CUSTER AVENUE • EVANSTON, ILLINOIS



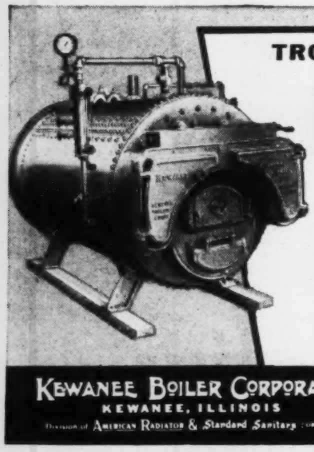
BALL THRUST BEARINGS

Standard sizes are shown in our general catalog.



STANDARD SIZES OR SPECIAL DESIGN to your specifications; send sketch or worn sample, regardless of condition, for quotation, without obligation. ● Our complete catalog will help you in making selection of bearings—shall we send it?

THE GWILLIAM CO. 360 FURMAN ST.
BROOKLYN 2, N.Y.



TROUBLE-FREE

KEWANEE SCOTTIE JR

- It lasts and lasts and lasts without break-downs. Easy to handle, every part accessible . . *it's truly trouble-free.* For any fuel

6 to 30 H. P.—100 lbs. W. P.

For 6" Scale with pipe diameter markings . . . WRITE Dept. 99-M2

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS
Division of American Radiator & Standard Sanitary Corporation

---

SPEED REDUCERS

AVAILABLE

TO BE MADE UP FOR

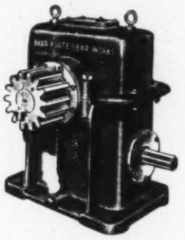
PROMPT DELIVERY

(SOME RATIOS IN STOCK)

WORM GEAR AND GYRO SPEED REDUCERS

Worm Gear Speed Reducers

SIZE	QUANTITY	RATIO	INPUT H.P. 1750 RPM	RATING AT 1150 RPM
3HT	73	5 1/6 to 1	3.3	2.6
	143	10 to 1	2.5	2.
	15	15 to 1	1.85	1.5
	51	20 to 1	1.4	1.1
	9	25 to 1	1.0	.9
	74	30 to 1	.97	.78
	150	40 to 1	.74	.60
	73	50 to 1	.63	.50
	50	60 to 1	.50	.39
3-3/4 HT	5	5 2/5 to 1	5.7	4.7
	3	7 to 1	4.8	3.9
	16	10 to 1	4.4	3.3
	26	14 1/2 to 1	3.2	2.5
	9	20 to 1	2.4	1.9
	43	30 to 1	1.7	1.34
	24	40 to 1	1.22	1.00
	25	50 to 1	1.05	.84
	90	60 to 1	.85	.68
1HT or HA	3	5.8 to 1	6.5	5.3
	10	10 to 1	4.56	3.72
	13	16 1/2 to 1	3.2	2.63
	25	20 to 1	2.66	2.18
	50	30 to 1	1.93	1.56
	2	40 to 1	1.47	1.21
	29	45 to 1	1.31	1.08
	48	60 to 1	.99	.81

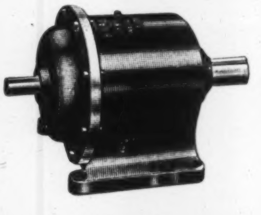


CATALOG 114

OFFERED Subject to Prior Sale

~

Write for prices and delivery dates



CATALOG 112

Gyro Speed Reducers

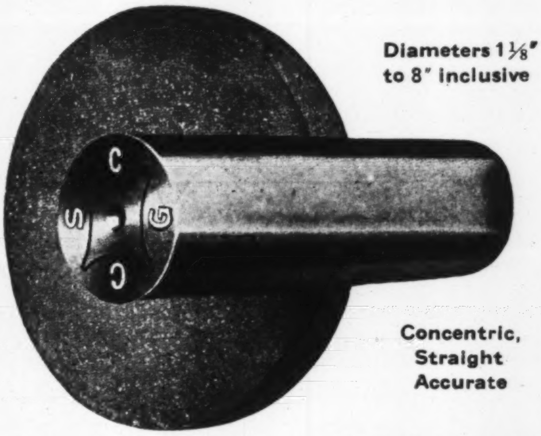
SIZE	QUAN.	RATIO	INPUT H.P. 1750 RPM	RATING AT 1150 RPM
G-7½	16	24 to 1	.87	.68
	9	30 to 1	.65	.50
	13	40 to 1	.48	.38
	8	50 to 1	.39	.30
	4	56 to 1	.35	.27
	10	60 to 1	.33	.25
	4	80 to 1	.26	.20
	4	100 to 1	.20	.16
	5	120 to 1	1/6	1/6
	3	200 to 1	1/6	1/6
	2	408 to 1	1/6	1/6
	4	480 to 1	1/6	1/6
G-15	7	30 to 1	1.3	.96
	9	40 to 1	.96	.74
	4	50 to 1	.77	.58
	35	60 to 1	.65	.47
	3	81-3/5 to 1	.50	.36
	55	120 to 1	.33	.25
	1	140 to 1	1/4	1/4
	1	360 to 1	1/4	1/4
G-25	8	40 to 1	1.5	1.
	9	50 to 1	1.25	.94
	39	60 to 1	1.04	.79
	1	66 to 1	.96	.70
	8	80 to 1	.80	.60
	9	100 to 1	.64	.44
	10	116 to 1	.55	.40
	28	118 to 1	.55	.40
	1	142 to 1	.40	.30
	10	200 to 1	.32	.25
	6	235 to 1	1/4	1/4
	1	247 to 1	1/4	1/4
	9	360 to 1	1/4	1/4
	7	480 to 1	1/4	1/4
	2	2080 to 1	1/4	1/4
G-40	2	26 to 1	4.2	3.00
	5	25 to 1	4.2	3.00
	4	30 to 1	3.8	2.8
	7	40 to 1	2.83	2.13
	6	50 to 1	2.27	1.74
	4	60 to 1	1.90	1.46
	3	101 to 1	1.1	.89
	4	120 to 1	.98	.75
	4	180 to 1	.66	.50
	1	240 to 1	.50	.38
	4	400 to 1	1/4	1/4
	3	480 to 1	1/4	1/4
	3	610 to 1	1/4	1/4
	4	1200 to 1	1/4	1/4

BRAD - FOOTE GEAR WORKS

1309 SO. CICERO AVE. CICERO, ILL. DEPT. A

CUMBERLAND GROUND SHAFTS

An Exclusive Product
Made by an Exclusive Method



Diameters 1⅛" to 8" inclusive

Concentric, Straight Accurate

MINIMUM ELASTIC LIMIT	MAXIMUM LENGTHS MANUFACTURED
Cumberland Brand—30,000 lb. per sq. in.	Year 1845—up to 16 ft.
Potomac Brand—45,000 lb. per sq. in.	Year 1886—up to 25 ft.
Cumsoo Brand—55,000 lb. per sq. in.	Year 1945—up to 70 ft.

They are carefully ground to our standard manufacturing tolerance, plus nothing to minus .002" on diameters 1-1/8" to 2-7/16" inclusive . . . plus nothing to minus .003" on diameters 2-1/2" to 8" inclusive. Closer tolerance can be furnished, if desired.

IMMEDIATE SHAFTS

DISTRIBUTED BY

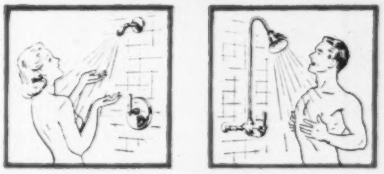
Baltimore, Maryland—Addison Clarke & Bro.
Boston, Mass.—Hawkridge Brothers Company
Boston, Mass.—Brown-Wales Company
Bridgeport, Conn.—Hunter & Havens, Inc.
Buffalo, New York—Jos. T. Ryerson & Son, Inc.
Chicago, Ill.—Central Steel & Wire Co.
Cincinnati, Ohio—Jos. T. Ryerson & Son, Inc.
Cleveland, Ohio—The Bissett Steel Company
Dayton, Ohio—Central Steel & Wire Co.
Detroit, Michigan—Central Steel & Wire Co.
Fort Worth, Texas—C. A. Fischer
Hartford, Conn.—Hunter & Havens, Inc.
Indianapolis, Ind.—Tanner & Company
Jersey City, N. J.—Jos. T. Ryerson & Son, Inc.
Kansas City, Mo.—F. H. Turner
Lakeland, Fla.—Mine & Mill Supply Co.
Los Angeles, Calif.—Link-Belt Co., Pacific Div.
Louisville, Ky.—Neill-LaVielle Supply Co.
Martinsburg, W. Va.—W. H. Heiston & Son
Montreal, Can.—Drummond, McCall & Co., Ltd.
New York City, N. Y.—Bright Steel Corp.
Oakland, Calif.—Link-Belt Co., Pacific Div.
Philadelphia, Pa.—Charles Bond Company
Philadelphia, Pa.—Horace T. Potts Co.
Pittsburgh, Pa.—McKee-Oliver, Inc.
Portland, Maine—W. L. Blake & Company
Portland, Oregon—Link-Belt Co., Pacific Div.
Providence, R. I.—Congdon & Carpenter Co.
Quebec, Canada—H. Duchene
San Francisco, Calif.—Link-Belt Co., Pacific Div.
Seattle, Wash.—Link-Belt Co., Pacific Div.
Spokane, Wash.—Link-Belt Co., Pacific Div.
Toronto, Canada—Drummond, McCall & Co. Ltd.
Worcester, Mass.—Pratt & Inman

CUMBERLAND STEEL COMPANY
CUMBERLAND, MARYLAND, U.S.A.
ESTABLISHED 1845 **INCORPORATED 1892**

When you want

THERMOSTATIC SHOWERS

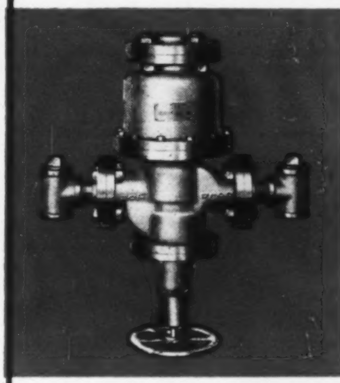
Remember **POWERS**



OFF
COLD
HOT
POWERS

POWERS Type H THERMOSTATIC MIXER For Individual Showers

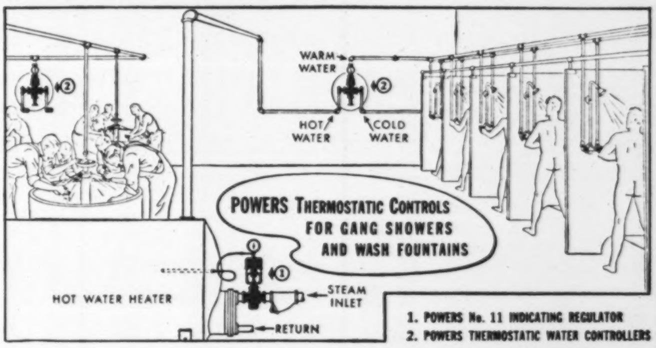
The BEST in Safety, Comfort and Economy has been achieved in this famous Powers Shower Mixer. Failure of cold water supply instantly cuts off the shower. Regardless of changing temperature or pressure in supply lines, the shower temperature remains constant. It is the safest mixer made. Size ½". Capacities: 6 and 10 gals. per min. at 45 lbs. pressure.
Dial diameter: Exposed mixer 3¼"; concealed mixer 6"



THERMOSTATIC WATER CONTROLLER

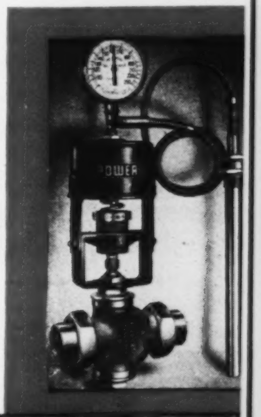
For Gang Showers

One Powers Controller will automatically deliver a supply of safely tempered water for as many as 25 showers. They are widely used for all types of multiple showers, wash-fountains, hot water line control and industrial processes. Available in various sizes with capacities, 22 to 125 gals. per min. at 45 lbs. pressure.


WARM WATER
HOT WATER
COLD WATER
②
②
POWERS THERMOSTATIC CONTROLS FOR GANG SHOWERS AND WASH FOUNTAINS
①
HOT WATER HEATER
STEAM INLET
RETURN
1. POWERS No. 11 INDICATING REGULATOR
2. POWERS THERMOSTATIC WATER CONTROLLERS

Only a few of our many types of controls are shown here. When you have a water temperature problem call in a Powers engineer. With over 50 years of experience we can help you whether the flow of water is 1 or 10,000 gals. per min. THE POWERS REGULATOR CO., Offices in 47 Cities
See Your Phone Book.

CHICAGO 14, ILL. 2751 Greenview Avenue
NEW YORK 17, N. Y. 231 East 46th Street
LOS ANGELES 5, CAL. 1808 West Eighth Street

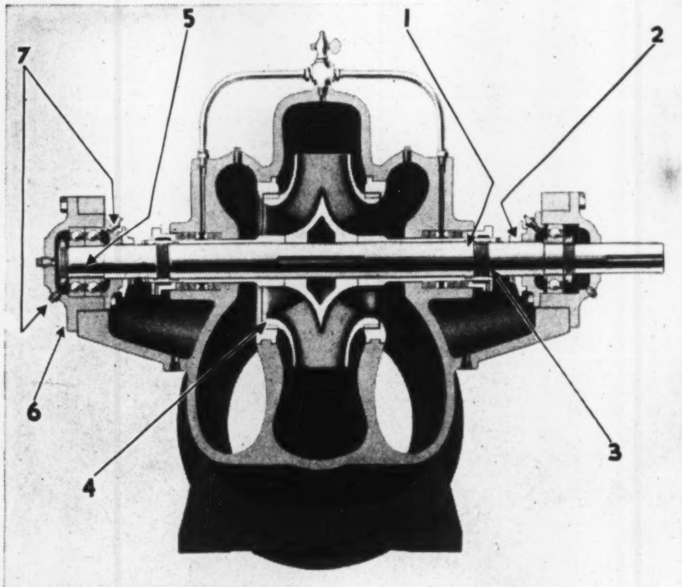


POWERS **No. 11 TEMPERATURE REGULATOR**
FOR
WATER HEATERS and INDUSTRIAL PROCESSES

Write for Catalog 3035

...check these ECONOMY features DESIGNED FOR HIGH EFFICIENCY!

1. Shaft sleeves are sealed to prevent leakage between sleeve and shaft.
2. Unusually effective water flinger.
3. No threads in center of shaft to start fatigue failure.
4. Wearing rings flanged; semi-labyrinth type.
5. Ball bearings secured to shaft according to best engineering practice, assuring maximum life.
6. Ball bearings are protected by cartridge enclosures so that complete rotor may be removed without exposing bearings to dirt or dampness.
7. Effective cross lubrication.



APPLICATIONS

General water supply.
Brine or hot water circulation.
City water booster service.
Hot well, condensate or makeup water service.
White water or overflow service in paper mills.

For full details, write Dept. CM-2 for your copy of Catalog No. A145.

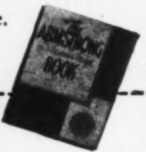
Economy Pumps Inc

HAMILTON, OHIO

the STEAM TRAP CLASSROOM

How do you calculate the warming up load of steam headers for purposes of trap selection?

YOU CAN FIND the answers in the new fourth edition of the Armstrong Steam Trap Book. Ask for your copy of this 36-page manual of useful information about steam, condensate drainage, traps, etc. It answers dozens of common questions and gives detailed information about Armstrong Traps for every purpose.



ARMSTRONG MACHINE WORKS
894 Maple Street, Three Rivers, Michigan.

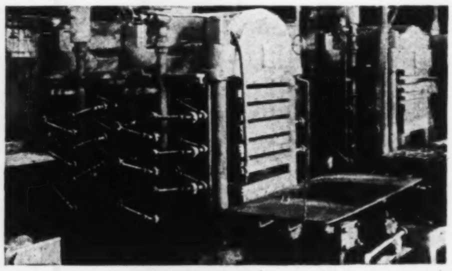
YES! I want a copy of your Steam Trap Book containing valuable information about condensate drainage problems.

NAME..........

COMPANY..........

ADDRESS..........

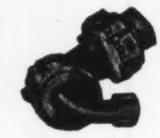
Please check: ☐ Plant Engineer ☐ Consulting Engineer ☐ Student Engineer



STYLE "A"

STYLE "B"

STYLE "F"


STYLE "H"

MEETING ALL MECHANICAL REQUIREMENTS WITH PLUS FEATURES

FLEXO JOINTS

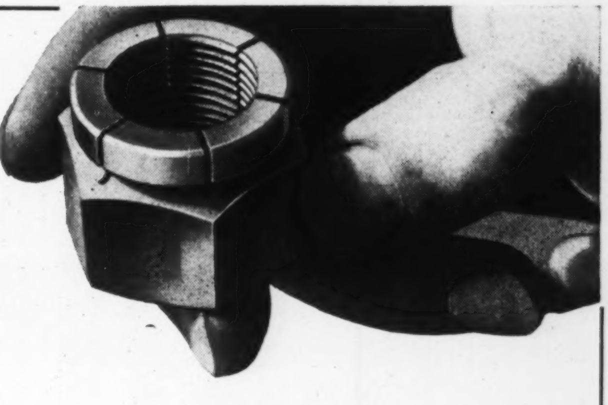
Steam condensate pockets are eliminated, and PIPE ALIGNMENT IS EXACT with FLEXO JOINTS. Engineering layouts may be made with assurance that FLEXO JOINTS will maintain an even flow of pressure and corresponding temperature.

Varied flexibility is provided in the four styles. Standard fittings for pipe sizes from ¼" to 3". 360° swivel movement. Under high or low pressure, to moving feed lines FLEXO JOINTS furnish dependable, long-life service for conveying steam, compressed air, water, oil, and other fluids.

Write for details—illustrated folder.

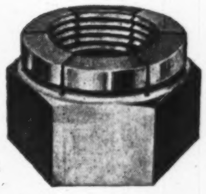
FLEXO SUPPLY CO., Inc.
4652 Page Blvd. St. Louis 13, Mo.
In Canada: S. A. Armstrong, Ltd., 115 Dupont St., Toronto 5, Ont.

FREE SAMPLES



FLEXLOC

SELF-LOCKING NUTS



Regular

Pat'd &
Pats. Pend.

Thin

The one-piece, all-metal "Flexloc" packs maximum usefulness in minimum space by combining, as it does, a stop, a lock and a plain nut all in one.

Every thread—including the locking threads—takes its share of the load. "Flexloc" accommodates itself to a wide range of thread tolerances . . . can be used over and over again without losing much of its locking torque . . . is not affected by temperatures likely to be met within the field of Mechanical Engineering . . . and being a "stop" nut, it stays locked in any position on the threaded member. The "Flexloc" is processed to have an exceptionally uniform torque.

The *Thin* "Flexloc" has become very popular because its *tensile* is so high and the space it occupies so small.

Sizes from #6 to 2" in diameter—in "regular" and "thin" types—in NC and NF thread series. Write for "Flexloc" Catalog.

OVER 45 YEARS IN BUSINESS

STANDARD PRESSED STEEL CO.
JENKINTOWN, PA. BOX 558
Boston, Chicago, Detroit, Indianapolis, St. Louis, San Francisco

?

IS YOUR COMPANY LISTED

IN THE

·A·S·M·E·

MECHANICAL CATALOG AND DIRECTORY

●

USE YOUR 1948 VOLUME
TO CHECK IF YOUR FIRM IS LISTED

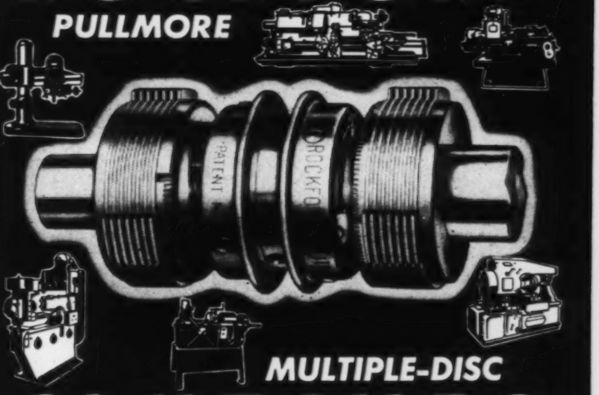
●

If not listed, write to us upon your Company letterhead, informing us under what product classifications your firm should be listed.

The American Society of Mechanical Engineers
29 West 39th Street, New York 18, N. Y.

ROCKFORD

PULLMORE



MULTIPLE-DISC

CLUTCHES

- COMPACT DESIGN
- HIGH TORQUE
- HIGH-RATIO LEVERS *
- POSITIVE NEUTRAL
- PRECISION BUILT
- LONG WEAR LIFE
- EASY ADJUSTMENT

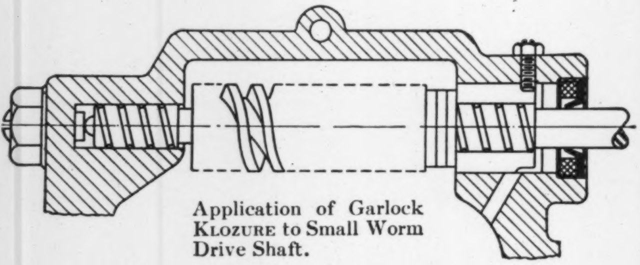
* High-ratio operating levers give PULLMORE clutches powerful engagement with slight axial pressure and short movement of the shifter spool; consequently operation is quick and easy. Declutching is equally fast and positive. The shifter spool has an extra deep slot which is hardened and ground. This prolongs the life of the clutch, reduces wear on the shifter fork and holds run-out to a minimum.

Send for This Handy Bulletin

Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

ROCKFORD CLUTCH DIVISION BORG-WARNER
1307 Eighteenth Avenue, Rockford, Illinois, U. S. A.

Illustration shows Model 53 Klozure which is produced in a range of sizes for 3" to 10" shafts. Model 63 Klozures, employing the same engineering principals but differing in details of design, are made in a range of sizes from ¼" to and including 3" shafts.



Application of Garlock Klozure to Small Worm Drive Shaft.

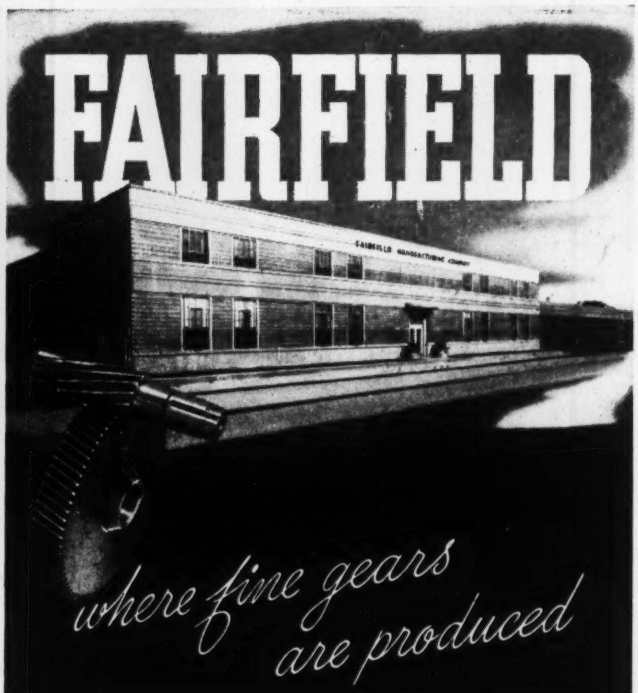
Garlock KLOZURE

OIL SEALS (Models 53 and 63)

Extreme sensitivity and flexibility of these new Models 53 and 63 Klozures reduce friction to a minimum and provide an efficient seal even on shafts having considerable "whip" or lateral movement. They give superior performance on high or low shaft speeds. For use under various operating conditions and on many different kinds of equipment.

THE GARLOCK PACKING COMPANY
PALMYRA, N. Y.
In Canada: The Garlock Packing Company
of Canada Ltd., Montreal, Que.

GARLOCK


FAIRFIELD
FAIRFIELD MANUFACTURING COMPANY
where fine gears are produced

EFFICIENTLY • ECONOMICALLY!

If you use gears in the product you make, we believe it will pay you, as it has many others, to become acquainted with FAIRFIELD — the place where fine gears are produced to meet your specifications EFFICIENTLY, ECONOMICALLY! Fairfield's production facilities are unexcelled for making all kinds of high precision, automotive type gears such as are now finding wide application in all branches of industry: for machine tools . . . for agricultural implements . . . for construction machinery . . . for printing presses. No matter how special your requirements may be, Fairfield has the equipment and the "know how" to meet virtually any need. Ask for a copy of interesting, illustrated descriptive brochure.

At Fairfield, YOUR GEARS are in the hands of specialists equipped with every modern facility for producing fine gears!

For FINE GEARS

FAIRFIELD MANUFACTURING CO.

331 So. Earl Avenue Lafayette, Indiana

Representatives—Sales Agencies
Business for Sale
Partnership—Capital
Manufacturing Facilities

OPPORTUNITIES

Positions Open—Positions
Wanted—Equipment, Material,
Patents, Books, Instruments,
etc. Wanted and For Sale

Answers to box number advertisements should be addressed to given box number care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

RATES Classified Advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.00 a line. 80 cents a line to members of A.S.M.E. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display Advertisements carried in single column units of multiples of one inch at flat rate of $15 per inch per insertion. Maximum size: 1 column, 10 inches deep, 2 columns, 5 inches deep. Copy must be on hand not later than the 10th of the month preceding date of publication.

POSITIONS OPEN

ANALYTICAL ENGINEERS
DESIGNERS
DRAFTSMEN

Excellent opportunities for technical personnel in the above categories, for work on advanced types of aircraft power plants.

Experience in heat cycles and applied mechanics desirable.

Address letters to Administrative Engineer stating age, marital status, details of education and experience.

PRATT & WHITNEY AIRCRAFT
Division of United Aircraft Corp.
East Hartford 8, Connecticut

EXPERIMENTAL AIRCRAFT GAS TURBINE LABORATORY

Urgently needs qualified personnel of extensive experience.
Experimental Stress Engineers for advanced Electro-Mechanical investigations on Gas Turbine components.
Development Engineers experienced in Fluid Mechanics of Turbo-Machines.
Advanced Aerodynamicist for Turbine component development in latest Supersonic Schlieren-equipped tunnel.
Other positions open for Mechanical, Electronic and Equipment Engineers.
For further information, write

E. C. Harrigan
PACKARD MOTOR CAR CO.
1330 Laskey Road, Toledo 12, Ohio

MECHANICAL DESIGN ENGINEER

With Administrative Experience
in the Design of
Steam Electric Stations
Preferably Between
35 and 45 Years of Age

LARGE EASTERN UTILITY
All Replies Strictly Confidential

Address CA-2483, care of "Mechanical Engineering."

MECHANICAL ENGINEERS
FOR RESEARCH

A variety of attractive vacancies, present and anticipated, for mechanical engineers interested in research and design. The expanding research program at Battelle, where more than 1000 are employed, offers excellent opportunities for growth, development, and advancement. Applications are treated confidentially and acknowledged promptly. Please address replies directly to

Battelle Memorial Institute
505 King Avenue
Columbus 1, Ohio

ENGINEERS—DESIGNERS

For Steel Valve Manufacturer in Chicago area. Position requires board work on development and design of new and existing products. Excellent opportunity with progressive company. Write for interview and outline your qualifications fully. Address: Personnel Dept., Edward Valves, Inc., East Chicago, Indiana.

ENGINEER-DESIGNER

to head drafting department for established manufacturer, New York City. Automotive and Materials Handling Equipment experience. Thorough knowledge of shop practice for economical production. Give complete résumé of background, in confidence. State salary expected.

Address CA-2521, care of "Mechanical Engineering."

Engineers - Designers

Immediate openings in Boston for men experienced in mechanical, structural, electrical and process work

Address application to:

STONE & WEBSTER
ENGINEERING CORPORATION
49 Federal Street
Box 118, Boston 7, Mass.

GRADUATE MECHANICAL ENGINEER

With several years of laboratory experience for research and development in excellently equipped mechanical laboratory. Please submit complete personal record, including photograph with application.

THE HOOVER COMPANY
North Canton, Ohio

PROFESSORSHIPS
IN MECHANICAL ENGINEERING

M.E. School of outstanding university in upstate New York has exceptional opportunities in key positions for graduate engineers with sound theoretical and practical background in (a) Heat-Power Engineering, steam and gas turbine power plants; (b) Machine Tools, Materials Processing and Manufacturing Methods. Salaries approximately $5000–$6000 for 9-month academic year, with opportunities for additional earnings, other benefits.

Address CA-2520,
care of "Mechanical Engineering."

TECHNICAL GRADUATES—(especially chemical, electrical and mechanical) under 35, have excellent opportunity for permanent position with nationwide engineering organization. After training period, work will include traveling for consultation among leading industrial plants. Address CA-2456, care of "Mechanical Engineering."

CHEMICAL ENGINEERS, MECHANICAL ENGINEERS, DESIGNERS of mechanical and process equipment. Employment in New York City or Stamford, Conn. Apply by letter only, stating education and experience to: Engineering Dept #1, Air Reduction Co., Inc., Rm. 1901, 60 East 42nd St., New York 17, N. Y.

YOUNG MECHANICAL ENGINEERS—for firm operating paper and sugar mills in Peru, South America. Living quarters provided. Knowledge Spanish desirable. Address CA-2499, care of "Mechanical Engineering."

MATERIALS HANDLING ENGINEER—for the design and checking of all types of conveyors, hoppers and bins. Excellent opportunity for one qualified to supervise engineering staff. Furnish detail record of education, experience, salary requirements and telephone number where applicant can be contacted. Location—Detroit. Address CA-2515, care of "Mechanical Engineering."

MECHANICAL DESIGNER—Instrument Field, Long Island Area. Must be capable of handling complete design of small, precision mechanical computers involving numerous automatic inputs. Address CA-2516, care of "Mechanical Engineering."

Continued on Page 118

Two Pages of Opportunities this Month—117-118

Continued from Page 117

POSITIONS OPEN

Continued from Page 117

MECHANICAL DESIGN ENGINEER—experienced in design and development of heavy machinery, preferably graduate engineer. Work includes layout and drafting. Excellent opportunity with progressive manufacturer. Give complete details in first letter, including education, experience, references and expected salary. Enclose recent photograph. The Eimco Corporation, P. O. Box 300, Salt Lake City 8, Utah.

DESIGNING DRAFTSMEN—for large Copper Company, Chile, South America to layout and detail industrial building and equipment. Mechanical draftsmen with structural steel and reinforced concrete experience preferred. 3-year contract. Transportation both ways and salary while traveling paid by the Company. In reply give complete details. Address CA-2525, care of "Mechanical Engineering."

POSITIONS WANTED

FACTORY MANAGER—Mechanical Engineer, post-graduate work in industrial engineering and chemical engineering. Age 47. 25 years' experience design and manufacture small, medium and large size process equipment and machinery. 15 years successful record as Factory Manager and Chief Engineer. Seeking similar position with progressive small or medium sized company. Location California. Salary $12,000 per year. Address CA-2503, care of "Mechanical Engineering."

MECHANICAL ENGINEER—Age 36, M.E. Graduate. Registered in several states. Broad background in supervision, development, design and application of steam generation. Would like to join small progressive firm manufacturing boilers or allied equipment as consultant, sales, or executive engineer. Address CA-2504, care of "Mechanical Engineering."

ENGINEER—with 25 years' experience in design, development and manufacture of chemical, foodstuffs, processing and hydraulic machinery, desires responsible position with small or medium size company. Address CA-2505, care of "Mechanical Engineering."

MECHANICAL ENGINEER—with successful experience in mechanical design development and presently in engineering education administration seeks industrial connection in executive classification, field of design and development. Age 34. Address CA-2506, care of "Mechanical Engineering."

MECHANICAL ENGINEER—with twenty years' experience in precision manufacturing: production methods, design of dies, tools and special machinery, product design, wishes to make new connection. Good organizer. Address CA-2507, care of "Mechanical Engineering."

MECHANICAL ENGINEER—Centrifugal Pumps. All types, experienced all engineering and manufacturing phases. Design, application, estimating, shop, research. Will consider position or business opportunity in this or other fields. All replies answered. Address CA-2508, care of "Mechanical Engineering."

MECHANICAL ENGINEER—BSME, age 27, Veteran, Junior ASME. Experience: Steam and Gas Turbine Design, Naval Engineering, and Engineering Testing. Desires position in Power Plant Engineering, Consulting Firm, or other position offering future. East desired. Address CA-2509, care of "Mechanical Engineering."

MECHANICAL ENGINEER—Eight years' experience engineering. estimating, quotations, sales custom built machinery and processing equipment. Desires similar work or connection with manufacturers' representative. Address CA-2510, care of "Mechanical Engineering."

ENGINEER—BSME: age 29: married: Experienced in plant engineering, maintenance, development and personnel management. Varied industrial background in machinery, rubber, and fertilizer manufacture. Desires responsible position in small organization. Address CA-2511, care of "Mechanical Engineering."

MECHANICAL ENGINEER—B.S.M.E., Registered, 30, married. Experience in casting design. Wishes change to Plastic Molding Design or Production. Not concerned with salary but with future. Prefer Detroit location, but will move. Address CA-2512, care of "Mechanical Engineering."

PROFESSOR—responsible position well known university, desires change next Fall. Applied Mechanics or allied subject. Particularly interested small progressive institute. Masters, doctors degrees, industrial, academic experience and research. Many published papers. About $6000. Address CA-2513, care of "Mechanical Engineering."

PRODUCTION SUPERINTENDENT—Age 38, with exceptional experience in production planning, design of tools and dies, basic machine and mechanical instrument design and development, job estimating and methods engineering. Capable of operating most machine tools expertly and who has had training and good experience as a fine executive. Desires position of trust and responsibility with progressive and intelligently led firm. Address CA-2527, care of "Mechanical Engineering."

ENGINEER—Young, mechanical, BS in ME, desires position in sales, production, or safety engineering. Two and one-half years experience in test and development engineering, one-half year as executive assistant in small factory. Philadelphia area most desirable. Will travel if necessary. Address CA-2530, care of "Mechanical Engineering."

REPRESENTATION WANTED

REPRESENTATIVES WANTED—To sell quality Seamless Flexible Metal Hose or Tubing. Territories in most principal cities available. Address CA-2528, care of "Mechanical Engineering."

REPRESENTATIVES AVAILABLE

SALES ENGINEER—with Chicago Loop Office has facilities to handle an additional Mechanical, Heating or Allied equipment account as Manufacturers Agent in the Middle West. Address CA-2478, care of "Mechanical Engineering."

MECHANICAL ENGINEER—desires to represent several production accounts in Northern Ohio or complete state of Ohio. 10 years varied experience in sales, production and design. Presently employed as chief engineer. Address CA-2529, care of "Mechanical Engineering."

If you desire capital or have it to invest; if you have a patent for sale or development; if you have on hand used machinery for disposal, or if you want such equipment; if you have copies of publications, or a set of drawing instruments to dispose of; if you need help or want a position, in fact, anything to be offered that someone else may want, or anything wanted that somebody else may have—

Use a Classified Advertisement in

MECHANICAL ENGINEERING

for Quick Results

EMPLOYMENT AGENCIES AND SERVICE BUREAUS

JOB RESULTS—Executive, technical, industrial personnel. Your experience record developed into a comprehensive, job-winning résumé, by mail. For details, write Personnel Counsel Service, 366 Madison Avenue, New York 17, N. Y.

PLANT PERSONNEL, ENGINEERS, DESIGNERS—Draftsmen, Chemists, and Metallurgists, E. G. Stroud, Member A.S.M.E. and President Cleveland Engineering Agency Co., 2132 E. 9th St., Cleveland 15, Ohio, will help you find positions or men.

SALARIED POSITIONS $3,500–$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (38 years recognized standing and reputation). The procedure, of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby Inc., 115 Dun Bldg., Buffalo 2, N. Y.

SALARIED PERSONNEL $3,000—$25,000

This confidential service, established 1927, is geared to needs of high grade men who seek a change of connection under conditions, assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited.

JIRA THAYER JENNINGS
Dept. J, 241 Orange Street, New Haven, Conn.

EQUIPMENT FOR SALE

FOR SALE

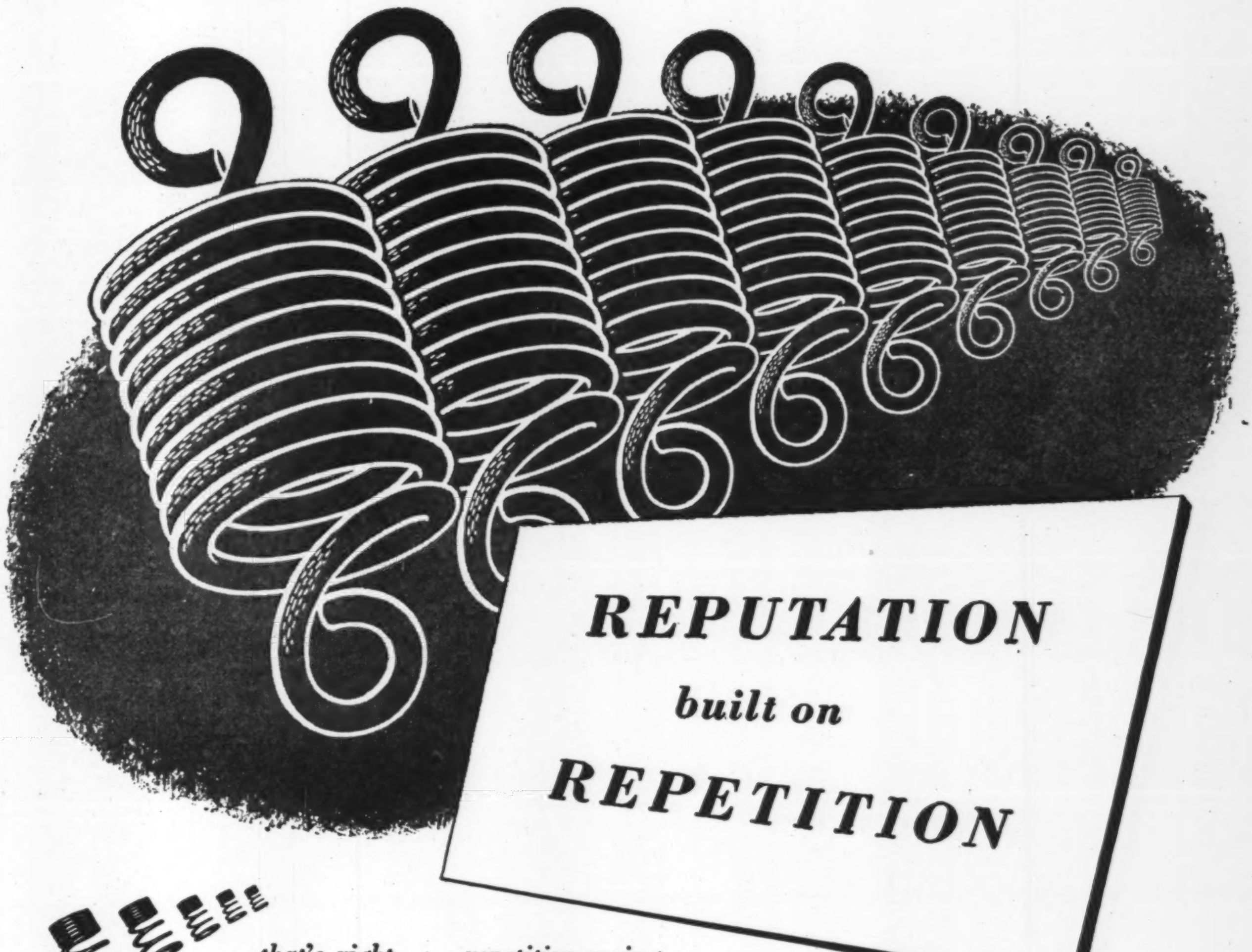
600 K.W. Allis-Chalmers .8 PF 440/3/60 Generator direct connected to 120 RPM Allis-Chalmers Cross Compound Steam Engine designed for 115 P.S.I.G. (H.P. cylinder can be sleeved at nominal cost with factory recommendation to operate at 175#), 450°F. maximum temperature, including generator panel also 440/360 M.G. Exciter.

Location: Near Honolulu, Hawaii.

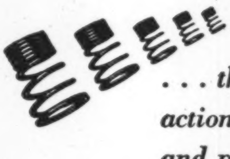
Offered by original purchaser. Condition excellent—has seen little use; very reasonably priced for quick sale. Write:

Alexander & Baldwin, Ltd.
Box 3440
Honolulu 1, Hawaii

It will pay you to read the announcements on this and the preceding page for an opportunity that you may be looking for or one that may be of interest to you.



REPUTATION built on REPETITION



. . . that's right . . . repetitive spring action that gives mechanisms life, pep and power . . .

Uniformity to specifications on repeat orders . . .

Job engineering that results repeatedly in production savings on simple or complex spring designs.

Barnes customers are usually "repeat" customers . . . the reasons for which our representatives will be glad to tell. Ask them at the first opportunity.

Wallace Barnes SPRINGS

SMALL STAMPINGS • WIRE FORMS • HAIRSPRINGS • COLD ROLLED SPRING STEEL

WALLACE BARNES COMPANY
BRISTOL, CONN.

DIVISION OF THE ASSOCIATED SPRING CORP.

AND IN CANADA, THE WALLACE BARNES CO., LTD., HAMILTON, ONTARIO

ENGINEERING SERVICE

Manufacturers of Equipment Not Included

RATE: **Announcements under this heading in MECHANICAL ENGINEERING are inserted at the flat rate of $2.00 a line per issue, $1.75 a line to A.S.M.E. members, minimum charge, three line basis. Uniform style set-up. Copy must be in hand not later than the 10th of the month preceding date of publication.**

MANUFACTURING PROBLEMS
Product Improvement—Methods—Cost Reduction
Manufacturing Organization—Controls
CONRAD BLISS
10 Park Place **Morristown, N. J.**

WALLACE CLARK & COMPANY
Management Consultants
Since 1920
MANAGEMENT AUDITS
521 Fifth Avenue **New York 17, N. Y.**

GREGORY M. DEXTER, C.E., M.E.
Consulting Engineer
Empire State Building, New York 1, N. Y.
Longacre 5-6982

Power Plants and Electrical Distribution for Industry
Surveys, Reports, Design, Construction, Supervision
EDWARD R. FEICHT
Bala-Cynwyd, Pa. (outside Philadelphia)

Pulp, Paper & Bag Mills . Structures . Equipment—
Design, Supervision, Inspection, Reports
HERSCHELL W. KELLEY
P. O. Box 948, New Brunswick, N. J.

I. JORDAN KUNIK
Registered Patent Attorney
75-H Pearl Street **Hartford 3, Connecticut**

Patents and Trade Marks
FRANK LEDERMANN, P.E.
Registered Patent Attorney
154 Nassau St., New York 7, N. Y.
Telephone BEekman 3-2936

JOSEPH LICHTENSTEIN
Engineers in the Design, Use and Economics of Cooling Towers, Pumps and Diffusional Equipment.
123 William Street, New York 7, N. Y.

Industrial Power—Surveys & Design
MYERS, FULLER & ADDINGTON
Consulting Engineers
21 East 40th Street, New York 16
Murray Hill 6-4630

Weld Testing—Qualification of Operators—Supervision—Inspection—Research
NATIONAL WELD TESTING BUREAU
Pittsburgh Testing Laboratory, Pittsburgh, Pa.

An announcement in this section will acquaint others with your specialized practice

---

CONSULT: **Z. H. POLACHEK**
Reg. Patent Attorney
1234 Broadway
(at 31st St.) New York 1, N. Y.
Phone LO 5-3088

RUDOLPH AU. SALZER
Member A.S.M.E.
Consulting Engineer
Standardization
Cost Analysis
Economic design
489 5th Ave., New York 17, N. Y
Phone: MU 2-2492

SANDERSON & PORTER
ENGINEERS and CONSTRUCTORS
New York . San Francisco . Chicago . Los Angele

Power Plants, Structures, Transmission Systems—Design
Supervision, Inspection, Appraisals, Reports.
SARGENT & LUNDY
140 S. Dearborn St., Chicago, Ill.

STERLING ENGINEERING COMPANY
Newark 5, N. J. **Mitchell 2-7321**
CONSULTING ENGINEERS
FOR MANUFACTURERS
Plant Layout and Conveyor Systems
Designers and Builders of
SPECIAL PURPOSE MACHINERY

Power Plants, Public Utilities, Industrial Plants
WESTCOTT & MAPES Inc.
Architects and Engineers
New Haven, Conn.

Squires
STEAM TRAP
The GENUINE Squires STEAM TRAP

Saves your fuel bill as it operates **without** loss of steam.

Sena for Catalog H-9 giving complete information.

The C. E. SQUIRES CO., Cleveland, O.

M.P.B. makes more than 40 types and sizes of miniature ball bearings

To carry radial and/or thrust loads in small precision mechanisms specify M.P.B. Miniature ball bearings.

We also design and manufacture special bearings.

Write for complete details in ME 37.

MINIATURE *Precision* BEARINGS
INCORPORATED
KEENE, NEW HAMPSHIRE, U. S. A.

Television stations get programs by telephone lines, too

Thousands of pairs of wire in telephone cables radiate from every central office. That is why cable pairs will be handy to link cameras and transmitters wherever a television program may originate.

Since cable pairs are designed first for voice transmission—top frequency, about 3200 cycles per second—the loss at picture frequencies up to 4,000,000 cycles is high, so an amplifier is inserted about every mile. Equalizing networks are also needed to bring the losses at all frequencies to the same value.

Recently, the Laboratories have developed a "video pair" in which polyethylene string and tape are used instead of paper, and which has a shielding copper tape over all. It is being built into new telephone cables which go to points where television programs are certain to originate. Losses are so much less that amplifiers can be four miles apart.

Inside an all-weather sheath, "video" travels safely and reliably alongside your telephone call, a sound program, telegraph signals, pictures for tomorrow's papers. This service of the telephone cable was ready when television needed it because of Bell Laboratories activity.

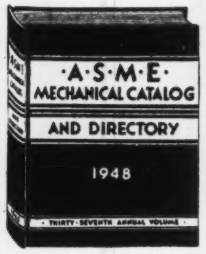
BELL TELEPHONE LABORATORIES *EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE*

Index To Advertisers

KEEP INFORMED—Pages 41-60 ENGINEERING SERVICE—Page 120 OPPORTUNITIES—(classified ads) Pages 117, 118

★ The asterisk indicates that firm also has product catalog in the 1948 A.S.M.E. Mechanical Catalog and Directory

The Only Reference Annual Covering the Mechanical Engineering Field with a Unique Combination of Complete Equipment Directory and Manufacturers' Catalogs. Up-to-date 20-page Insert Catalog of A. S. M. E. Publications is included.



Published Annually By
The American Society of Mechanical Engineers
29 West 39th St., New York 18, N. Y.

Adel Precision Products Corp. 103
Air Reduction Sales Co. 2
*Aldrich Pump Co. 25
Allegheny Ludlum Steel Corp. 15
Alteneder, Theo. & Sons 110
*American Brass Co., American Metal Hose Branch 79
A.S.M.E. Publications 106
Arkwright Finishing Co. 58
*Armco Drainage & Metal Products (Inc.) 20
*Armstrong Machine Works 114
*Automotive Gear Works 69

*Babcock & Wilcox Co. *2nd Cover*
Baldt Anchor, Chain & Forge Div., Boston Metals Co. 42
*Barco Mfg. Co. 92
*Barnes, Wallace, Co., Div. Assoc. Spring Corp. 119
Bell Telephone Laboratories 121
*Brad-Foote Gear Works. 112
Briggs & Stratton Corp. 51
*Brownell Co. 111
Bruning, Charles, Co. 95
*Buffalo Forge Co. 31
Bundy Tubing Co. 71

Carrier Corp. 27
Century Electric Co. 9
Chicago Float Works 42
Climax Molybdenum Co. 49
Consolidated Engineering Corp. 43
Cumberland Steel Co. 113

*DeLaval Steam Turbine Co. 49, 84
*Detroit Stoker Co. 3
Diamond Chain Co. (Inc.) 98
Dow Corning Corp. 42
Dowell (Inc.) 23
*Downingtown Iron Works 56
DuMont, Allen B., Laboratories 59

Earle Gear & Machine Co. 110
Eastman Kodak Co. 61
Economy Pumps (Inc.) 114
Edward Valves (Inc.), Sub. of Rockwell Mfg. Co. 22
Electrol (Inc.) 8
*Erie City Iron Works 11

Faber, A. W.-Castell Pencil Co. 45
*Fafnir Bearing Co. 65
Fairbanks, Morse & Co. 105
Fairfield Mfg. Co. 116
Farval Corp. 97
Flexo Supply Co. 114
*Foote Bros. Gear & Machine Corp. 124
*Foster Engineering Co. 6
*Foxboro Co. 89
Fulton Sylphon Div., Robertshaw-Fulton Controls Co. 33

*Garlock Packing Co. 116
Gear Specialties 5
*General Electric Co. 19, 82, 83
General Radio Co. 70
*Gibson, Wm. D., Co., Div. Assoc. Spring Corp. 26
*Gifford-Wood Co. 107
Gits Brothers Mfg. Co. 60
Gladden Products Corp. 49
Goodrich, B. F., Chemical Co. (Hycar) 94
Graphite Metallizing Corp. 48
*Grinnell Co. 99
*Gwilliam Co. 112

Haering, D. W. & Co. 50
Hannifin Corp. 64
Helicoid Gage Div., American Chain & Cable 47
Hyatt Bearings Div., General Motors Corp. 96
*Hydropress (Inc.) 7

Imperial Tracing Cloth 52
Indiana Steel Products Co. 32
International Nickel Co. 34
Irving Subway Grating Co. 44

*James, D. O., Mfg. Co. 109
Jenkins Bros. 40
*Johnson, Carlyle, Machine Co. 63
Joy Mfg. Co. 123

Kellogg, M. W., Co. 39
Keuffel & Esser Co. 67
*Kewanee Boiler Corp. 112

Laminated Shim Co. 46
Layne & Bowler (Inc.) 48
*Leeds & Northrup Co. 14
Linear Incorporated 76
*Link-Belt Co. 102
*Lord Mfg. Co. 93
*Lovejoy Flexible Coupling Co. 109
Lubriplate Div., Fiske Bros. Refining Co. 54
Lukens Steel Co. 30, 100
Lunkenheimer Co. 53

*Mason-Neilan Regulator Co. 78
*Mears-Kane-Ofeldt (Inc.) 54
Miniature Precision Bearings 120

*National Airoil Burner Co. 80
*New Departure Div., General Motors Corp. 1
Nice Ball Bearing Co. 87
Nooter, John, Boiler Works Co. 55
Nordstrom Valve Div., Rockwell Mfg. Co. 28, 29
Northern Indiana Brass Co. 86

Pacific Pumps (Inc.) 73
*Peabody Engineering Corp. 21
*Peerless Pump Div., Food Machinery Corp. 44
Permutit Co. *3rd Cover*
Philadelphia Gear Works 62
Polarizing Instrument Co. 50
*Powers Regulator Co. 113
*Prat-Daniel Corp. 68
*Propellair Div., Robbins & Myers 24

*R-S Products Corp. 66
Robbins & Myers, Moyno Pump Div. 81
*Robertson, John, Co. 88
Rockford Clutch Div., of Borg-Warner Corp. 115
*Roots-Connersville Blower Corp. 37

*SKF Industries (Inc.) 13
*Sarco Co. 111
*Schutte & Koerting Co. 85
Smith, Winfield H., Corp. 75
Smooth-On Mfg. Co. 111
Sponge Rubber Products Co. 16
Squires, C. E., Co. 120
Stackpole Carbon Co. 74
Standard Pressed Steel Co. 4, 110, 115
Stuart, D. A., Oil Co. 52

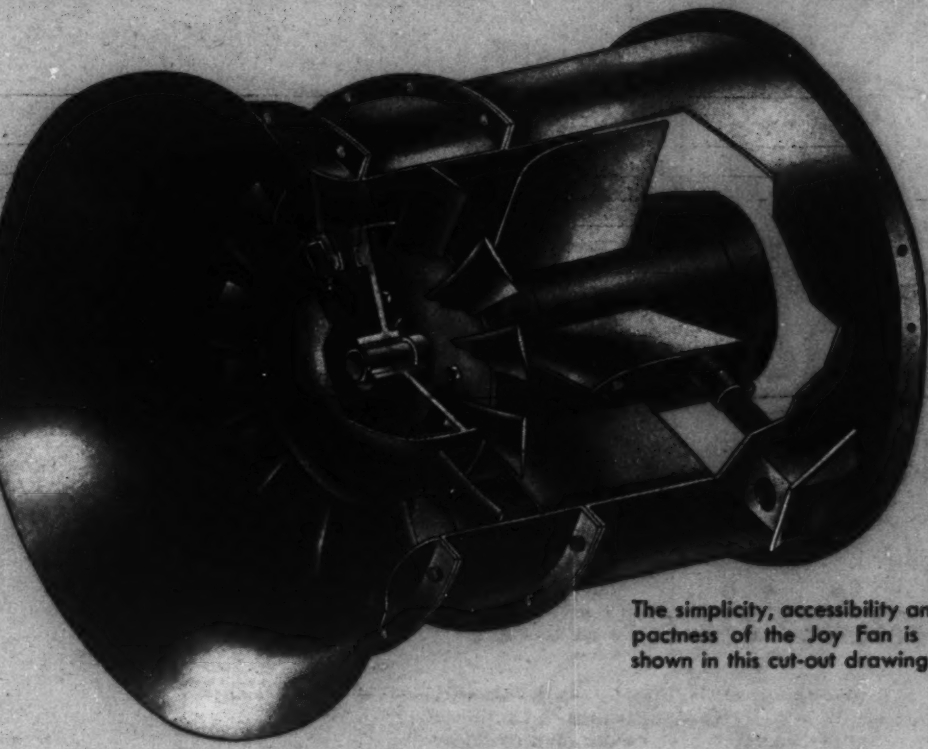
*Taylor Forge & Pipe Works 101
*Taylor Instrument Cos. 104
*Terry Steam Turbine Co. 108
Thomas Flexible Coupling Co. 45
*Timken Roller Bearing Co. *4th Cover*
Trane Co. 72
*Tube Turns (Inc.) (*Insert*) 17, 18
Tuthill Pump Co. 60
*Twin Disc Clutch Co. 10

Waldes-Kohinoor (Inc.) 77
Walworth Co. 12
Waterman Engineering Co. 112
White, S. S., Industrial Div., S. S. White Dental Mfg. Co. 57
*Wickes Boiler Co. 90, 91
Wisconsin Motor Corp. 56

*Yarnall-Waring Co. 35

ENGINEERING SERVICE

Bliss, Conrad deK. 120
Clark, Wallace & Co. 120
Dexter, Gregory M. 120
Feicht, Edward R. 120
Kelley, Herschell W. 120
Kunik, I. Jordan 120
Ledermann, Frank 120
Lichtenstein, Joseph 120
Myers, Fuller & Addington 120
National Weld Testing Bureau 120
Polachek, Z. H. 120
Salzer, Rudolph Au 120
Sanderson & Porter 120
Sargent & Lundy 120
Sterling Engineering Co. 120
Wescott & Mapes (Inc.) 120



The simplicity, accessibility and compactness of the Joy Fan is clearly shown in this cut-out drawing.

"SERIES 1000"

JOY AXIVANE FANS

TROLLER DESIGNED

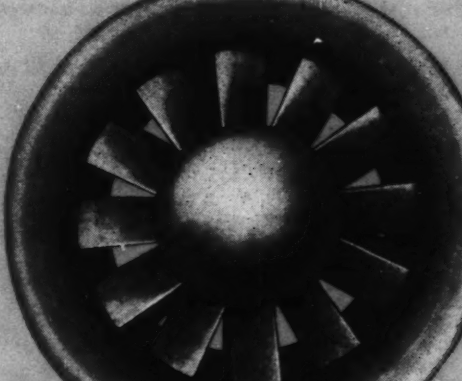
More efficient—lighter—more compact—easily and economically installed.

A very complete line of stock Vaneaxial fans in sizes and capacities to cover practically any industrial need.

Volumes up to 100,000 C.F.M.
Pressures up to 9.6" W. G.
Housing diameters 18" to 60".

Compact—easier to install—efficient—with an exclusive Joy feature, on-the-job adjustable Blades, permitting change of pressures and correction of duct resistance.

Write for Bulletin describing the "Series 1000" line—now ready!



Front view, showing self-enclosed motor and clean-cut design.

Call for a Joy Engineer

JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

4 tons suspended in midair!

HERE is the Navy's new transport Helicopter—the Piasecki HRP-1. Suspended in midair, its giant rotors can support four tons of gross weight—can carry nine or ten men to safety in an emergency.

Both of the main rotor transmissions produced by Foote Bros. incorporate "A-Q" (aircraft quality) Gears.

These revolutionary gears achieve a new peak in performance due to the extreme precision—the extraordinary techniques developed in heat treatment—the control of every step in production, from the billet to the finished gear. They offer manufacturers of any type of equipment maximum strength with minimum weight—the advantages of compactness and low noise level. They permit operation at extremely high speeds.

.... Foote Bros. "A-Q" Gears may offer your engineers a solution to the problems they face.

.... Foote Bros. high-quality Commercial Gears are backed by complete facilities and nearly a century of gear manufacturing experience.

.... Foote Bros. Actuators and Power Units provide a new approach to power control on aircraft or on machinery where designers face unique problems in control.

.... Foote Bros. Speed Reducers offer a wide range of sizes and ratios, in both worm and helical, to meet any reduction requirements.

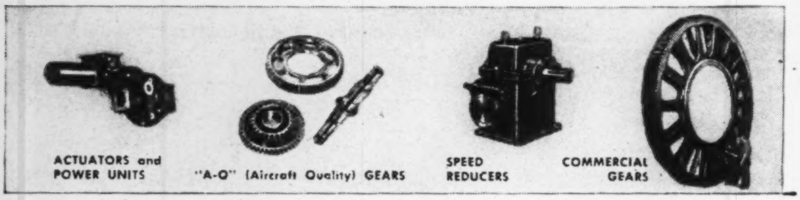
Regardless of what you require in power transmission, call on Foote Bros.

FOOTE BROS. GEAR AND MACHINE CORPORATION
Dept. Q, 4545 S. Western Ave, Chicago 9, Ill.

This planetary transmission produced at Foote Bros. for the Piasecki Helicopter Corporation transmits power from the Pratt & Whitney engine to drive the two giant rotors. The characteristics of high speed, compactness, high efficiency and low noise level are assured by the "A-Q" (aircraft quality) Gears which turn the rotor shaft. Two of these units are required for each Helicopter.

* * *

For further data on Foote Bros. gears, speed reducers and power units—Mail the Coupon.



For information on power transmission equipment produced by Foote Bros. in which you are interested, check this coupon.

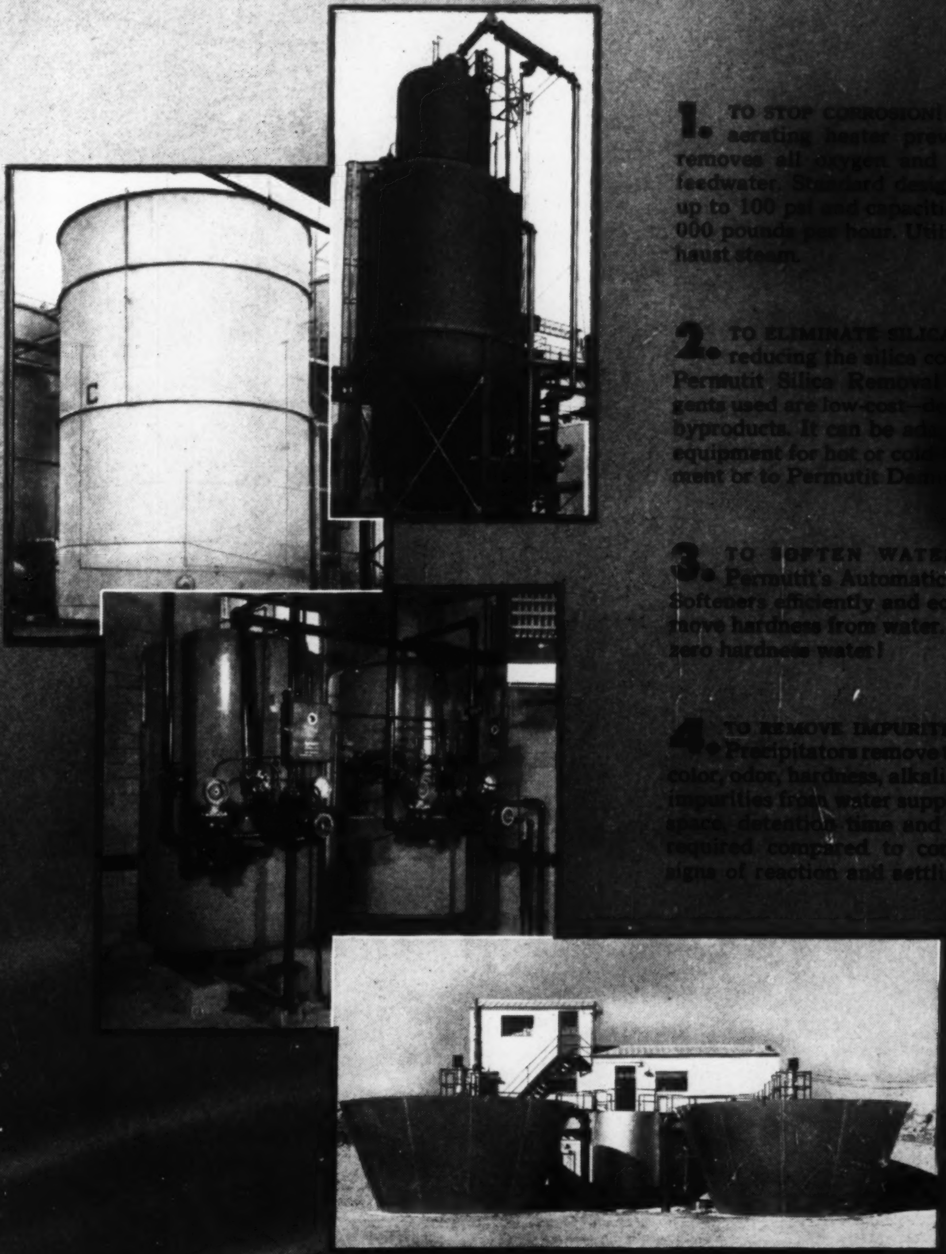
☐ FOLDER "WHATEVER YOUR NEEDS IN GEARS"
☐ BULLETIN "AIRCRAFT QUALITY GEARS"
☐ BULLETIN "FOOTE BROS. POWER UNITS"

Name...
Address......................................
City............................*State*..........

FOOTE BROS.

Better Power Transmission Through Better Gears

Water engineered
to any requirement!



1. TO STOP CORROSION! Permutit's Deaerating heater prevents corrosion, removes all oxygen and free CO_2 from feedwater. Standard designs for pressure up to 100 psi and capacities up to 1,000,000 pounds per hour. Utilizes bleeder or exhaust steam.

2. TO ELIMINATE SILICA SCALE . . . by reducing the silica content with The Permutit Silica Removal [illegible] Reagents used are low-cost—do not add soluble byproducts. It can be adapted to existing equipment for hot or cold lime soda treatment or to Permutit Demineralizers.

3. TO SOFTEN WATER SUPPLIES! Permutit's Automatic Zeolite [illegible] Softeners efficiently and economically remove hardness from water. The effluent is zero hardness water!

4. TO REMOVE IMPURITIES! Permutit's Precipitators remove turbidity, taste, color, odor, hardness, alkalinity, and other impurities from water supplies. Much less space, detention time and chemicals are required compared to conventional designs of reaction and settling tanks.

Write for full information on this equipment to The Permutit Company, Dept. [illegible], 330 West 42nd St., New York 18, N.Y. or to Permutit Company of Canada, Ltd., Montreal.

Permutit

WATER CONDITIONING HEADQUARTERS FOR [illegible] YEARS